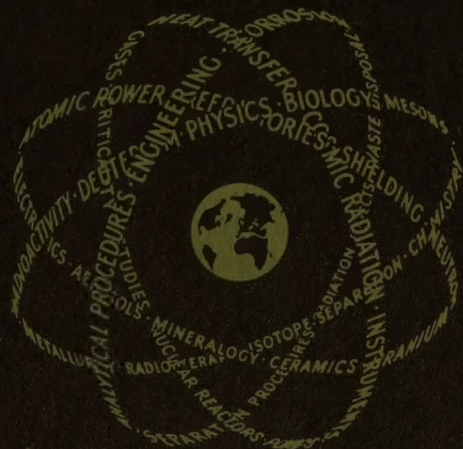


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NUCLEAR SCIENCE ABSTRACTS

Volume 14 Number 5

March 15, 1960

GENERAL AND MISCELLANEOUS

4147 AFCRC-TR-53-5(Del.)

Air Force Cambridge Research Center. Geophysics Research Directorate, Mass.

CONFERENCE (NO. 31): WEATHER EFFECTS ON NUCLEAR DETONATIONS, [FEBRUARY 2-3, 1953, BOSTON]. B. Grossman, ed. Feb. 1953. Decl. with deletions Sept. 29, 1959. 182p. OTS.

Information given in a conference held at Boston, Feb. 2-3, 1953 is presented. Abstracts are included for 14 papers on weather effects such as those on blast pressures, thermal radiation, fallout, and related problems. (J.R.D.)

4148 AFCRC-TR-53-5(Del.) (p.1-10)

Naval Ordnance Lab., [White Oak, Md.]

THE INFLUENCE OF ATMOSPHERIC PRESSURE AND TEMPERATURE VARIATIONS ON SHOCK WAVE PROPAGATION. F. Theilheimer. 10p.

A review of the influences of air pressure and temperature variations with altitude on the pressure due to an explosion is presented. Explosions valued at 10,640 and 5120 KT (TNT) are considered. (J.R.D.)

4149 AFCRC-TR-53-5(Del.) (p.11-15)

Air Force Cambridge Research Center. Geophysics Research Directorate, Mass.

METEOROLOGICAL EFFECTS ON LONG RANGE BLAST WAVE INTENSITY. J. A. Peoples, Jr. 8p.

The weaker disturbances which can occur at 10 to 100 miles from the source of an explosion are discussed. Minor meteorological effects on blast wave propagation are omitted. A simplified acoustic theory is presented and ray tracing examples are given. Experimental observations are outlined and applications to offensive action are proposed. (J.R.D.)

4150 AFCRC-TR-53-5(Del.) (p.16-23)

Naval Ordnance Lab., [White Oak, Md.]

WEATHER EFFECTS ON BLAST PROPAGATION. G. K. Hartmann. 12p.

Theory concerning the energy absorbed by liquid water in the atmosphere when it is evaporated by heated air from a blast is examined. The time for the evaporation to occur is emphasized and its relation to quantity of water per unit volume in air and the droplet size are considered. It is shown that the per cent loss in energy due to water is roughly two-thirds of the per cent loss in energy. Photographs of shock wave interaction with a drop are included. (J.R.D.)

4151 AFCRC-TR-53-5(Del.) (p.24-7)

Air Force Cambridge Research Center. Geophysics Research Directorate, Mass.

THE ATTENUATION EFFECTS OF FOG OR RAIN ON THE PEAK BLAST PRESSURE FROM AN A-BOMB. Hervey P. Gauvin. 6p.

Scaling laws concerning the attenuation of blast pressure by rain or fog are examined. The application of these laws in the conversion of HE bomb scaling to A-bombs detonated under similar conditions is emphasized. Experiments in which 1000 lb bombs were fired are described where no evidence of attenuation was found. Other pressure data on atmosphere containing liquid water also showed no evidence of attenuation. The results are not considered positive, however, it appears that the effects are not serious enough to affect delivery of atomic bombs. (J.R.D.)

4152 AFCRC-TR-53-5(Del.) (p.28-9)

Air Force Cambridge Research Center. Geophysics Research Directorate, Mass.

THE EFFECT OF CHANGES IN ATMOSPHERIC CONDITIONS ON PEAK BLAST OVERPRESSURES. N. A. Haskell. 2p.

Variations in atmospheric conditions are discussed and a specific numerical example is presented in which a 70 KT bomb is exploded at 2500 ft over a target at sea level. Incident overpressures at ground level with three widely different atmospheric states are calculated. (J.R.D.)

4153 AFCRC-TR-53-5(Del.) (p.30-5)

Armed Forces Special Weapons Project, Washington, D. C. THERMAL RADIATION FROM ATOMIC WEAPONS. Herbert Scoville, Jr. 8p.

The meteorological factors which affect the thermal radiation from atomic explosions are examined. These factors are considered as those which affect the energy which is received by the target, and those which alter the susceptibility of the target to the thermal radiation. It is concluded that the chief factors which affect energy transmission include cloud cover, inversion layers, and particulate matter in the air, while those affecting the target susceptibility include the recentness of rain, relative humidity, and factors which affect the target's ability to sustain fire, and the spread of large scale fires. (J.R.D.)

4154 AFCRC-TR-53-5(Del.) (p.36-42)

Naval Ordnance Lab., [White Oak, Md.]

WEATHER EFFECTS ON THERMAL RADIATION. H. S. Stewart. 8p.

A review of atmospheric effects on thermal radiation from atomic explosions is presented. The mechanism by which light radiates from the explosion is discussed and a

lecture, accompanied by slides, is presented on the developments which occur after explosions. Chemical effects of high atmospheric temperatures are discussed and various spectral aspects are examined. (J.R.D.)

4155 AFCRC-TR-53-5(Del.) (p.43-9)

Air Force Cambridge Research Center. Geophysics Research Directorate, Mass.

ENVIRONMENT ALBEDO AND ITS EFFECTS ON THE THERMAL RADIATION FROM AN ATOMIC BOMB DETONATION. Robert M. Chapman. 11p.

Reflections of thermal radiation by a cloudy atmosphere and/or a reflecting ground surface, both of which return a portion of their received energy to the attenuating atmosphere, but with a different geometry and spectral distribution, are considered. Methods of approaching the problem are outlined and the radiation due to reflection from an infinite plane due to a radiation source placed near that plane is theoretically analyzed as an example of one approach. (J.R.D.)

4156 AFCRC-TR-53-5(Del.) (p.51-5)

Air Force Cambridge Research Center. Geophysics Research Directorate, Mass.

THE AFCRC PROGRAM ON METEOROLOGICAL ASPECTS OF SCAVENGING BY RAINFALL. C. E. Andersen. 8p.

Fall-out from atomic explosions due to assistance by rainfall is examined. Aspects of the radioactivity accretion process are considered. It is estimated that a large part of the radioactive particles in the fall-out area are less than 1 micron in radius. The remaining part is above 1 micron and some of this is greater than 100 microns. Data on collection efficiency as related to droplet size are presented and an average collection efficiency is derived. A research program is also described in which a tower is used to study rainfall washout effects. (J.R.D.)

4157 AFCRC-TR-53-5(Del.) (p.56-63)

Air Research and Development Command, [Baltimore]. SCAVENGING ACTION OF SOIL DEBRIS AND RAIN ON THE ATOMIC CLOUD. N. M. Lulejian. 11p.

An experiment is described in which sand and dirt are mixed with an atomic cloud and the scavenging is correlated with that of rain. The shortcomings of the method are noted and it is pointed out that only an order of magnitude is the object of the experiment. Data from test operations such as tumbler-snapper are presented. It is concluded that it is possible to create hazardous radioactive contamination in the immediate vicinity of ground zero by the scavenging action of rain on a 1 to 2 KT bomb. Military implications of larger bombs are also considered. (J.R.D.)

4158 AFCRC-TR-53-5(Del.) (p.64-70)

Air Weather Service, Washington, D. C.

FALLOUT FORECASTING AT THE NEVADA PROVING GROUND. Clifford Spohn. 12p.

Details of forecast preparation for tests at the Nevada Proving Ground are presented. Pre-shot briefing is discussed and the technique of fall-out forecasts is described. Rates of particle fall are considered along with wind forecasts, and the basis for several other assumptions. Also an analysis of error is given and the basis of deriving the absolute error is presented. Typical fall-out plots are included. (J.R.D.)

4159 AFCRC-TR-53-5(Del.) (72-85; 87)

Weather Bureau, Washington, D. C.

THE DEPOSITION OF DEBRIS FROM ATOMIC TESTS. Lester Machta. 29p.

Fall-out at distances of 200 miles or more from atomic

explosions is investigated. The levels are low, however, there is public interest and the data serve as a basis for estimating the maximum size bombs which can be detonated at the Nevada Proving Ground. Data from nationwide monitoring are given and the mechanism of transport is analyzed. Preparation of a meteorological trajectory is discussed and estimates of their accuracy are given. Descent rate of small particles is analyzed and statistics of cloud spread are presented. The scavenging effects of falling precipitate are examined, and data on efficiency of various droplet size are tabulated. Forecasting the deposition of debris is discussed and fall-out maps of the U. S. show fall-out after Tumbler-Snapper. (J.R.D.)

4160 AFCRC-TR-53-5(Del.) (p.89-95)

Weather Bureau, Washington, D. C.

THE SPREAD OF AIRBORNE DEBRIS FROM ATOMIC EXPLOSIONS DURING THE 12 HOUR PERIOD FOLLOWING DETONATION. P. W. Allen. 10p.

The medium range spread of debris from atomic blasts between the time when it is visible and the point where it begins to be of a size about the same as the large scale motions of the atmosphere is examined. Cloud outlines are presented on map overlays for various shots. (J.R.D.)

4161 AFCRC-TR-53-5(Del.) (p.104-10)

RAND Corp., Santa Monica, Calif.

THE RISE AND DEVELOPMENT OF AN ATOMIC CLOUD. William W. Kellogg. 11p.

A program is described in which atomic cloud development is documented from the time of the burst to the time when it could no longer be seen. Wide angle cameras were used and the coverage was for about 3 hours. Descriptions and diagrams are included. (J.R.D.)

4162 ITR-1704

Army Engineer Research and Development Labs., Fort Belvoir, Va.

GROUND MOTION MEASUREMENTS. Feb. 1959. 22p. Project 26.3 [of] OPERATION HARDTACK, PHASE II. OTS.

Measurements were made of strong ground motion occurring in the medium surrounding the Evans event of Operation Hardtack Phase II. Due to the low yield of the Evans device no usable records were obtained from the event. A preliminary analysis is given of measurements of strain and acceleration made on the Tamalpais event in an effort to improve the instrumentation for Evans. A tentative correlation of data on accelerations and strains from contained underground explosions in the Oak Springs tuff indicates that the effectiveness of Tamalpais in causing ground motion was less than 10% of that expected on the basis of cube root scaling from a 1-ton, fully stemmed HE model test. (auth)

4163 SCR-131

Sandia Corp., Albuquerque, N. Mex.

ECONOMIES IN MATERIAL HANDLING. R. D. Flaxbart. Nov. 1959. 7p. OTS.

An analysis of those problems connected with handling of the most common items in stores, warehouses, and yards is presented. Present methods are reviewed and new developments are discussed. It is concluded that chief among areas of improved techniques lies in the reduction of the number of times individual items have to be handled. (J.R.D.)

4164

INSURANCE AND LIABILITY QUESTIONS IN THE FIELD OF NUCLEAR ENERGY. H. Hagmaier and E. Pohl. Atom u. Strom 5, No. 5, 33-40 (1959) May. (In German)

The German insurance business is presently disturbed at the risk to be taken and the applications to be made of atomic energy, in offering the necessary insurance protection. It is shown that, from the problematics of nuclear fission and especially from the problem of liability insurance with the late-injury danger entering in, it is unreasonable that the insurance management be asked for premium quotations for such installations, the technical structure of which is still undergoing alteration, and for which there is absolutely no experience with the protection of the plants available. (T.R.H.)

4165

CHARACTERISTICS AND PERFORMANCE OF NUCLEAR POWERED SUBMARINE CARGO VESSELS. J. A. Teasdale (Furness Shipbuilding Co.; Ltd., [Eng.]). J. Joint Panel Nuclear Marine Propulsion 3, 49-62(1959) Oct.

The characteristics and performance of a submarine tanker are discussed and compared with a surface tanker of the same deadweight, both vessels being propelled by nuclear power. The characteristics and performance of circular and elliptical submarines are compared. The circular form was found superior to surface vessels but it would meet with restrictions at terminal ports due to its draught. The economics of operation at normal and high speeds are discussed. (C.J.G.)

4166

RADIATION DAMAGE. REPORT FROM BRITISH ASSOCIATION MEETING. C. S. Grace (Royal Military College of Science, Shrivenham, Eng.). Nuclear Energy Engr. 13, 596-9(1959) Dec.

Four papers, delivered at the annual meeting of the British Association for the Advancement of Science, on the different aspects of radiation damage are briefly reviewed. Emphasis is placed on radiation damage in reactors and the mechanisms of radiation effects in biological materials. (D.E.B.)

4167

ECONOMICAL STORAGE OF OIL AND GAS PROMISED BY CONSTRUCTING UNDERGROUND STORAGE FACILITIES WITH NUCLEAR EXPLOSIONS. Roland H. Carlson (Sandia Corp., Albuquerque, N. Mex.). Petrol. Engr. 3p. (1959) Aug.

The author concludes that application of underground nuclear bursts for blasting out huge underground storage cavities for oil and gas storage is not only technically feasible, but could result in large monetary savings. (C.H.)

4168

AEC AUTHORIZING LEGISLATION, FISCAL YEAR 1960. HEARINGS BEFORE THE SUBCOMMITTEE ON LEGISLATION OF THE JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES, EIGHTY-SIXTH CONGRESS, FIRST SESSION ON AEC AUTHORIZING LEGISLATION, FISCAL YEAR 1960, FEBRUARY 7, 27; MARCH 23, 24, 25; APRIL 13, 14, 15, AND MAY 8, 1959. Washington, D. C., Joint Committee on Atomic Energy, 1959. 706p.

Authorizing legislation for various projects involving nuclear research under contract to the United States Atomic Energy Commission for the fiscal year 1960 is presented. Cost summaries are presented for these various projects. The advances made by various research projects are discussed. (C.J.G.)

4169

ECONOMIA DELL'ENERGIA ATOMICA. RASSEGNA BIBLIOGRAFICA E DI DOCUMENTAZIONE. [Economics of Atomic Energy: Bibliographic and Reference Survey.

Third Edition.] Rome, Banca Nazionale del Lavoro, 1959. 104p.

A bibliography of the most important publications in the world on the economics of atomic energy utilization is presented. The publications of international organizations are listed. The listing is arranged according to country. Information as to the availability of the literature is given. (J.S.R.)

BIOLOGY AND MEDICINE

General and Miscellaneous

4170 ORINS-30

Oak Ridge Inst. of Nuclear Studies, Inc., Tenn. MEDICAL GAMMA-RAY SPECTROMETRY. D. A. Ross. Dec. 10, 1959. 39p. OTS. Bound with ORNL-2808.

Problems are discussed which are encountered in measuring gamma radiation after the administration of radioisotopes to patients. The design, performance, and operation of a medical gamma-ray spectrometer are described. (C.H.)

4171 UCRL-8930

California, Univ., Berkeley. Lawrence Radiation Lab. THE PHOSPHOLIPIDE AND PHOSPHOLIPIDE-FATTY-ACID COMPOSITION OF HUMAN SERUM LIPOPROTEIN FRACTIONS. Gary J. Nelson and Norman K. Freeman. Oct. 1959. 21p. Contract W-7405-eng-48. OTS.

The phospholipide compositions of human serum lipoproteins have been determined on ultracentrifugally separated serum lipoprotein classes by silicic acid column chromatography and infrared spectrophotometry. The phospholipides were separated into a fraction containing phosphatidyl-ethanolamine and phosphatidyl serine, a lecithin fraction, and a sphingomyelin fraction. All phospholipides are present in each lipoprotein class, but their distributions in each class are sufficiently different to be characteristic. Analyses were run on sera from five individuals and only small deviations from the average values were observed. In a few cases the fatty acids of the separated phospholipides were analyzed by gas chromatography. (auth)

4172 SCL-T-286

TRANSFUSION AND GRAFTING OF MARROWBONE CELLS IN MAN. (Transfusion et Greffe de Cellules Myéloïdes Chez l'Homme). Georges Mathé. Translated by Marcel I. Weinreich (Sandia Corp.) from p.1-41 of "Colloquium on Grafting," Liege, 1959. 39p. JCL.

Procedures and results are reported from the transfusion of bone marrow in patients with radiation injuries or leukemia. Chemical and serological methods for determining that the graft has taken are discussed. Preparation of the patient, choice of donor, removal of marrow, injection procedure, and care of the patient after the injection are discussed. It is pointed out that if the grafting takes, the patient must be watched for several months for possible signs of a secondary syndrome. (C.H.)

4173

THE RADIATION DOSE TO THE KIDNEY OF THE RAT FROM INHALED RADON. Donald A. Morken (Univ. of Rochester, N. Y.). A.M.A. Arch. Ind. Health 20, 505-09(1959) Dec.

The α -radiation dose from RaA and RaC' required to produce kidney lesions is about 290 rad for mice inhaling radon. This dose is considerably less than thought necessary for other radiations. Reasons are advanced for

this apparent high effectiveness of the RaA and RaC' α particles. (auth)

4174

AN INVESTIGATION OF THE LATE CLINICAL FINDINGS FOLLOWING THOROTRAST (THORIUM DIOXIDE) ADMINISTRATION. William B. Looney (National Naval Medical Center, Bethesda, Md.). Am. J. Roentgenol., Radium Therapy Nuclear Med. 83, 163-85(1960) Jan.

The status is reviewed of 35 patients who received thorotrast during clinical studies. A summary is presented of previously published histopathologic, autoradiographic, radiochemical, and spectrochemical findings. Results of laboratory findings are reviewed. The general problem of radiation dosimetry, hematologic findings, skeletal findings, clinical follow-up studies, and carcinogenesis in thorotrast patients is included in the discussion. Reports of deterring effects of thorotrasts, since its first use in 1928, are few. 131 references. (C.H.)

4175

DOSE-RATE MEASUREMENTS IN THE RABBIT TIBIA FOLLOWING UPTAKE OF STRONTIUM 90. Maureen Owen and Janet Vaughan (Nuffield Dept. of Medicine, Oxford). Brit. J. Radiol. 32, 714-24(1959) Nov.

An account is given of an autoradiographic method of measuring radiation dose-rate in bone following uptake of Sr^{90} . The dose-rate pattern in the upper half of the tibia of young and old rabbits given a single injection of Sr^{90} or fed daily pellets containing Sr^{90} is described. The ratios maximum dose-rate/average dose-rate and maximum dose-rate/minimum dose-rate have been measured. For rabbits fed Sr^{90} from the age of five to eight weeks the greatest values of these ratios are 3.1 and 4, respectively. For rabbits given a single injection at the age of five to eight weeks they are 6 and about 70. For rabbits given a single injection, aged one year and more, they are 7 and 14. It is concluded that the non-uniformity of radiation dose-rate for Sr^{90} as determined by the ratio maximum dose rate/average dose-rate is never great for the long bones. The greatest value found was 7. (auth)

4176

THE INTRACAVITARY TREATMENT OF THE BLADDER WITH RADIOACTIVE COLLOIDAL GOLD. G. M. Dyche and N. R. Mackay (Royal Cancer Hospital, London and Royal Marsden Hospital, London). Brit. J. Radiol. 32, 757-63(1959) Nov.

The advantages of using a radioactive colloidal solution for the treatment of the bladder mucosa are discussed. A system for the introduction of the gold-198 into the bladder is described. Details are given of the physical technique and the method of assessing the radiation dose to the bladder mucosa is outlined. The clinical results based on 41 patients showed that in general the bladder was completely tumor free at the first follow-up in 20% of the patients treated and that these remained tumor free. More commonly the great majority of the tumors were cleared but a few neoplasms persisted and these were successfully treated by transurethral diathermy. Post-irradiation complications were observed in four patients. While avoiding some of the disadvantages of the technique of treating the bladder mucosa with a radioactive fluid in a latex rubber balloon the use of colloidal radioactive gold suffers from the disadvantage of a very rapid fall-off in depth dose. An isotope with a more energetic β emission, available in stable colloidal form, would appear to be more suitable for bladder treatment. (auth)

4177

EFFECT OF BREATHING ATMOSPHERES OF DIFFERENT

OXYGEN CONCENTRATIONS UPON SKIN AND DEPILATORY REACTIONS PRODUCED BY X RAYS IN THE LEGS OF MICE. C. W. Wilson (Westminster Hospital, London). Brit. J. Radiol. 32, 764-7(1959) Nov.

Experiments are described which show that the skin and depilatory reactions produced by x rays in the legs of mice are dependent upon the concentration of oxygen in the atmosphere breathed by the mice at the time of irradiation. An atmosphere containing only 10% of oxygen produced a radiosensitivity about 16% less than that for air. An atmosphere of oxygen produced a radiosensitivity about 9 to 10% greater than that for air. The dose dependence of the reactions is discussed and the value of the method used for determining them is emphasized. (auth)

4178

A STUDY OF INHALED ARSENIC-74 IN MAN. Robert H. Holland, Mary Sue McCall, and Henry C. Lanz (Univ. of Texas Southwestern Medical School, Dallas). Cancer Research 19, 1154-6(1959) Dec.

Data are presented on the uptake, distribution, absorption, and elimination of arsenic-74 in man following inhalation. (C.H.)

4179

SOME OBSERVATIONS ON THE CHEMISTRY AND BIO-CHEMISTRY OF BERYLLIUM. Jack Schubert (Universität, Bern). Chimia (Switz.) 13, 321-8(1959) Oct. (In German)

The history and development of Be are reviewed, and its geochemistry, radiochemistry, analytical chemistry, chemical properties, biochemistry, and toxicology are discussed. (T.R.H.)

4180

THE TREATMENT OF MEATS WITH IONISING RADIATIONS. I. CHANGES IN ODOUR, FLAVOUR, AND APPEARANCE OF CHICKEN MEAT. R. S. Hannan and H. J. Shepherd (Low Temperature Research Station, Cambridge, Eng.). J. Sci. Food Agr. 10, 286-95(1959) May.

On irradiation of chicken meat with 4-Mev and 2-Mev cathode rays, irradiation odors were apparent at 50,000 rads but irradiation flavors were not noted until the dose reached 250,000 rads—a dose which is known to extend the storage life at 5° at least threefold. The effect of a number of variables on reducing the irradiation odors and flavors has been examined, including temperature during irradiation, oxygen content, method of cooking, age, breed, diet of the birds, and storage after irradiation. Irradiation in a frozen condition at -75° is the most effective procedure examined. Approximately a threefold reduction in odor and flavor can be produced. (auth)

4181

THE TREATMENT OF MEATS WITH IONISING RADIATIONS. II. OBSERVATIONS ON THE DESTRUCTION OF THIAMINE. G. M. Wilson (British Food Mfg. Industries Research Assn., Leatherhead, Surrey, Eng.). J. Sci. Food Agr. 10, 295-300(1959) May.

In a study of the changes induced in foods by ionizing radiations the destruction of thiamine in meat has been measured as one indication of chemical change. Under a given set of conditions the breakdown is related to the dose of radiation. The effect of varying the internal and external environment at the time of irradiation has been studied. Freezing to -75° has been found to be the most effective method of preventing the destruction of thiamine. (auth)

4182

STUDIES ON THE DISCRIMINATION OF Sr^{90} FROM DIPLOID AND TETRAPLOID RED CLOVER AND Ca^{45} IN FEEDING EXPERIMENTS WITH MICE. Bertil Rasmuson

and Bo Gahne (Inst. of Plant Systematics and Genetics, Uppsala), and Lars Fredriksson (National Agronomy Experiment Station, Uppsala). Kgl. Lantbruks-Högskol. Ann. 25, 241-51(1959)

Diploid and tetraploid red clover was cultivated on different Ca levels with a constant addition of Sr^{90} in the soil. At all levels the diploid showed a greater uptake of both Ca and Sr^{90} per dry weight. The uptake of Sr^{90} from this diploid and tetraploid clover was investigated with mice as experimental animals on an adequate synthetic diet with calcium derived solely from the clover. There was no divergence in percentual uptake of Sr^{90} from the diploid clover and from the tetraploid, but the total difference in Sr^{90} activity that was found in the plant material was retained in the animal body. To the diet was added Ca^{45} to compare the strontium and calcium metabolism. The mice discriminated against strontium in relation to calcium ($\text{OR}_{\text{body-diet}} = 0.27$). The major discriminating factors were computed ($\text{DF}_{\text{absorptive}} = 0.45$ and $\text{DF}_{\text{urine}} = 0.58$). Consideration must be taken of the fact that Sr^{90} was derived from plant material. (auth)

4183

INTERSTRAIN OVARIAN TRANSPLANTATION IN LETHALLY IRRADIATED MICE AFTER BONE MARROW THERAPY. W. St. Amand and L. H. Smith (Oak Ridge National Lab., Tenn.). Nature 184, Suppl. No. 19, 1503-04(1959) Nov. 7.

Results are reported from experiments in marrow therapy in lethally irradiated mice. Both induced tolerance and lethal irradiation followed by bone marrow therapy improved the outlook for successful homologous transplantation of ovarian tissue in mice. (C.H.)

4184

RADIOMETRIC ACTION OF LIPOXIDASE. P. Puig Muset, J. Martin Esteve, and J. Valls Mateu (Consejo Superior de Investigaciones Cientificas, Barcelona and Laboratorio P.E.V.Y.A., Barcelona). Nature 184, Suppl. No. 19, 1506-07(1959) Nov. 7.

Results are reported from a study of the radiometric action of lipoxidase in mice. (C.H.)

4185

DISTRIBUTION OF PROMETHIUM PLASMA FRACTIONS IN RATS. Bergene Kawin (Michigan State Univ., East Lansing). Nature 184, Suppl. 22, 1722-3(1959) Nov. 28.

Preliminary results are presented which indicate that selective distribution in tissues of promethium-147 may be related to combinations with plasma fractions following injection. (C.H.)

4186

INHIBITION OF FOREIGN SPLEEN REACTION BY INACTIVATION OF DONOR CELLS WITH RECIPIENT ANTIGEN. G. E. Cosgrove, A. C. Upton, R. A. Popp, and C. C. Congdon (Oak Ridge National Lab., Tenn.). Proc. Soc. Exptl. Biol. Med. 102, 525-7(1959) Dec.

C57BL mouse spleen cells incubated with (C57BL $\times$ 101) F_1 liver homogenate killed only 17% of sublethally irradiated (C57BL $\times$ 101) F_1 recipients, whereas when incubated with C57BL liver homogenate or injected without incubation such cells killed 100% of sublethally irradiated (C57BL $\times$ 101) F_1 recipients within 35 days. Although the immunologically inactivated spleen cells showed a decreased ability to kill, circulating donor-type erythrocytes were found in surviving recipients, indicating repopulation of the bone marrow by surviving graft-derived stem cells. From this, it is inferred that immunologic

inactivation did not result from nonspecific destruction of all types of implanted cells. (auth)

4187

EFFECT OF Sr^{90} ON FLUORIDE RETENTION IN THE RAT. Joseph C. Muhler, George K. Stookey, and Martin J. Wagner (Indiana Univ. Medical School, Indianapolis). Proc. Soc. Exptl. Biol. Med. 102, 644-7(1959) Dec.

Administration of Sr^{90} and fluoride together does not increase retention of either Sr^{90} activity of fluoride in the whole carcass or femur of the rat. Preliminary evidence suggests, on the contrary, that presence of fluoride may decrease the amount of Sr^{90} retained by the rat. (auth)

4188

A LIMITED SURVEY OF RADIATION EXPOSURE FROM MEDICAL FLUOROSCOPES. Robert Owen Gorson, Jesse Lieberman, and Marvin Green (Dept. of Public Health, Philadelphia). Radiology 73, 898-910(1959) Dec.

Results are presented from a survey of radiation characteristics and manner of use of 81 fluoroscopes owned by hospitals and private practitioners. Survey techniques consisted of interviews with the physician, physical inspection of the fluoroscope, and radiation measurements. Fluoroscopes used by hospitals and radiologists produced, on the average, radiation at lower exposure levels than those used by nonradiologists. It was estimated that over 90% of the fluoroscopes could be made acceptable by the addition of aluminum filtration, decreasing the maximum setting, decreasing the maximum shutter opening, or adding accessory shielding. (C.H.)

4189

ERYTHROCYTE REPOPULATION AFTER TRANSPLANTATION OF HOMOLOGOUS ERYTHROPOIETIC TISSUES INTO IRRADIATED MICE. R. D. Owen (Oak Ridge National Lab., Tenn.). 12p. of "Colloque International sur les Problemes biologiques des Greffes, Université de Liège, du 18 au 21 mars, 1959."

Serological marker methods were used for defining and following transplantation of homologous erythropoietic tissues in irradiated mice. A lytic system is described for measurement of the proportion of red cells hemolyzed by antibody and complement. Reaction mechanisms involved in tissue transplantation are discussed. (C.H.)

4190

DIAGNOSTIC RADIOISOTOPES. Charles A. Owen. Springfield, Ill., Charles C. Thomas, 1959. 439p.

A review is presented of the diagnostic uses of radioactive elements and compounds. Emphasis is placed on precise methods of measurement. Physiologic principles and techniques are presented for those radioisotopic methods already established as diagnostically useful. Newer and incompletely tested procedures which appear likely to become diagnostically useful are also discussed. Author and subject indexes are included. 1054 references. (C.H.)

4191

PROCEEDINGS OF THE SECOND UNITED NATIONS INTERNATIONAL CONFERENCE ON THE PEACEFUL USES OF ATOMIC ENERGY, HELD IN GENEVA, 1 SEPTEMBER-13 SEPTEMBER, 1958. VOLUME 27. ISOTOPES IN AGRICULTURE. Geneva, United Nations, 1958. 463p. \$14.00.

Papers are included on applications of isotopes in studies on plant physiology, animal physiology, soil studies, and plant genetics and crop improvement. (C.H.)

4192

RADIOAKTIVE ISOTOPE IN KLINIK UND FORSCHUNG. III. VORTRAGE AM GASTEINER INTERNATIONALEN SYMPOSION, 1958. (Radioactive Isotopes in Medicine and Research. III. Contributions At The Gastein International Symposium, 1958). K. Fellingner and H. Vetter, eds. Munich-Berlin, Urban und Schwarzenberg, 1958. 371p.

The papers presented at the Third Gastein Conference and the discussions made on each paper are given. The subjects include "Hematological Investigations in the Clinical Application of Radioactive Gold Colloid," "The Effect of Whole Body Irradiation on Bone Marrow as Studied by Radioactive Iron Incorporation," "Affecting the Radioinduced Inhibition of DNA by Cysteine in Normal and Reduced Metabolism," "Use of Isotopes in Clinical Studies of Skeletal Metabolism," "Radiation Dosimetry Aspects of Bone Tumor Production," "Respiration and Fermentation in Cultures of Fibroblasts and HeLa Tumors," "Investigations on the Schizoid Problem with C^{14} -labeled d-Diethylaminelysergic Acid and C^{14} -labeled Succinic Acid," "Autoradiographic Investigations of Protein Metabolism in the Cells of the Central Nervous System of Rabbits and Rats," "Quantitative Determination of Iodine-Albumin Bonding in Tissues on a Radiohistochemical Basis," "The Kinetics of Blood Purification of Colloidal Suspensions as a Measurement of the Hepatic Circulation," "Studies of Liver Blood Flow in Man," "Radiogold and Bromosulfalein Clearance of Plasma as a Clinical Test of the Liver Function," "The Efficiency of Purification of the Human Liver with Respect to Colloidal Radioactive Gold (Au^{198}). Preliminary Study of a New Technique for the Measurement of the Purification Efficiency," "Measurement of Liver Blood Flow with Colloidal Radiogold (Au^{198})," "Advantage of Radioactive Labeled Substances in Clearance and Distribution Research," "A Method for the Determination of the Absolute Iodine Uptake in the Thyroid Gland and an Indirect Method for the Determination of the Concentration of Inorganic Iodine in the Blood," "Hemodynamics: Interpreted by Means of Multiple Scintillation Detectors Placed Over the Anterior Thoracic Wall," "Diagnostic Value of Selective Quantitative Radiocardiography," "Iron Metabolism Studies in Liver Cell Damage," "Hypophysis and Iron Metabolism: V. Influence of ACTH on Rat Erythropoiesis," "Radioactive Tracer Studies of Red Cell Survival in Tumor Bearing Rats," "Radio Paperchromatographic Investigations on the Specificity of the Bonding of (Co^{60})-Vitamin B_{12} Analogs to Intrinsic Factor Concentrates," "The Life Span of Cr^{51} -labeled Erythrocytes at Various Ages," "Hypophysectomy for Advanced Breast Cancer Using High Energy Particle Beams-Proton and Alpha Particles," "The Radiological Hypophysectomy by Implantation of Au^{198} ," "Experiences with Yttrium-90 Hypophysectomy," "Analysis of the Behavior of I^{131} -albumin in the Normal Subject and Nephrotic Patient," "A Practical Method for Plasma Albumin Turnover Studies," "Rapid Protein Breakdown in Idiopathic Hypoproteinemia," "Isotope Studies on the Regulation of Muscular Blood Circulation," "Diagnosis of Venous Return Flow Disturbances with Radiolodine Tissue Clearance," "Photoscanning: A Preliminary Report of a Simplified Graphic Method for the *in vivo* Pre-operative Localization and Recording of Brain Tumors," "Probability of Interest of the External Detection by 'Bremsstrahlung' of Radiophosphorus P^{32} in the Organism," "A Comparison of the Tissue Distribution of Colloidal Yttrium-90 and Gold-198 in Mice after Intraperitoneal Injection," and "The Distribution of Radioyttrium and Rare Earths in Organism in Different Application Methods." (J.S.R.)

Biochemistry, Nutrition, and Toxicology

4193 UR-557

Rochester, N. Y. Univ. Atomic Energy Project. AUTORADIOGRAPHIC OBSERVATIONS FOLLOWING THE INHALATION OF POLONIUM-210 IN RATS. Louis J. Casarett. Sept. 3, 1959. 35p. Contract W-7401-eng-49. OTS.

After inhalation exposures to a NaCl aerosol carrying Po-210, rats were sacrificed at time intervals ranging from immediately to 30 days post-exposure. Autoradiograms were made from all major tissues and were examined for intra-organ distribution of polonium with special attention on those aspects dealing with the mechanisms of removal of colloids from the lung. Deposition was primarily parenchymal and phagocytosis of colloids was virtually complete by 2 hours after exposure. Particulate material was transported up the respiratory tree, but there was also entry of phagocytized material into interstitial spaces. Considerable amounts of material were cleared from the lung via the lymphatic system. Solubilization of the colloids apparently occurred resulting in a virtual absence of colloids by 30 days after exposure. Solubilization was especially rapid in phagocytes and in lymphoid tissue. Implications of radiation dosage resulting from the changing distribution in the lung and the redistribution to other tissues are discussed as are the relations of the autoradiographic observations to concepts of lung clearance mechanisms. (auth)

4194 UR-558

Rochester, N. Y. Univ. Atomic Energy Project. THE TOXICITY OF POLONIUM. W. L. Downs, J. K. Scott, L. T. Steadman, and E. A. Maynard. Sept. 16, 1959. 57p. Contract W-7401-eng-49. OTS.

Data are presented on the toxic effects of indium, administered as a chloride ($InCl_3$) or as an oxide (In_2O_3), in rats, rabbits, and dogs. Data are included on the tissue distribution and excretion of indium-114. (C.H.)

4195 AEC-tr-3794

MATERIALS ON THE TOXICOLOGY OF RADIOACTIVE SUBSTANCES. PART I: STRONTIUM, CESIUM, RUTHENIUM, AND RADON. (Materialy po Toksikologii Radioaktivnykh Veshchestv. Vypusk I: Strontsiy, Tseziy, Ruteniy i Radon). A. A. Letavet and E. B. Kurlyandskaya, eds. Translated from a publication of the State Publishing House of Medical Literature, Moscow, 1957. 239p. OTS.

Data are tabulated from studies on the absorption, distribution, and excretion of strontium-89-90, cesium-134, ruthenium-106, and radon in laboratory animals. Data are included on the effects of chronic and high-dose exposure to the radioactive substances. The effects of nonradioactive strontium lactate and magnesium sulfate on the removal of radioactive strontium from the skeleton, and the effects of the subcutaneous administration of stable cesium on the excretion of radioactive cesium are discussed. (C.H.)

4196 AEC-tr-3923

CERTAIN FEATURES IN THE DEVELOPMENT OF PROGENY IN DOGS SUBJECTED TO THE ACTION OF PRODUCTS OF U FISSION. A. P. Novikova and S. P. Voskresenskiy (Voskresensky). Translated by A. L. Monks (Oak Ridge National Lab.) from *Med. Radiol.* 4, No. 2, 15-19 (1959). 7p. JCL or LC.

Uranium and uranium fission products absorbed by fe-

male dogs are transmitted to all litters born within four years. Growth retardation and increased mortality rate were noted in the offspring. Data are summarized from observations on 382 puppies. (C.H.)

Fallout and Radiation Ecology

4197 AERE-R-3094

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England and United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Woolwich Outstation, England.

THE DEPOSITION OF FISSION PRODUCTS FROM DISTANT NUCLEAR TEST EXPLOSIONS—RESULTS TO MID-1959. R. N. Crooks, M. J. Owers, R. G. D. Osmond, and E. M. R. Fisher. Oct. 1959. 12p. BIS.

Collection of rainwater samples has continued at seven stations in the United Kingdom and at eighteen stations elsewhere. At Milford Haven (Pembrokeshire) and Abingdon (Berkshire) samples are collected at monthly intervals and are analyzed for Sr^{90} , Sr^{90} , and Cs^{137} . At the other stations samples are collected at three monthly intervals and analyzed for Sr^{90} and Cs^{137} . The total deposition of Sr^{90} in the 12 months ending June, 1959 at Milford Haven was 7.1 mc/km^2 compared with 3.6 mc/km^2 in the previous 12 months. (auth)

4198 AFSWC-TN-59-1

Air Force Special Weapons Center, Kirtland AFB, N. Mex. WATER CONTAMINATION IN FALLOUT AREAS. Gordon G. Robeck, Richard L. Woodward, and William K. Muschler. May 1958. 50p. Project No. 7806. Contract AF29(601)-56-1836.

An evaluation of the potential radiological hazard to Air Force personnel from drinking water contaminated with fission products is presented. Ground water supplies should be safe from fall-out contamination and only surface supplies may need special treatment. Even in untreated water, the radioactivity in surface supplies is not likely to reduce significantly the military effectiveness of personnel using it except where the general level of contamination is greater than 1000 r/hr at H + 1. Dust samples were collected at the Priscilla shot of Operation Plumbbob 24 June 1957. In each of the samples, material containing approximately 10% of the activity was soluble; however, strontium was preferentially dissolved by a factor of 5. For the first 10 days after fall-out, a supply of one gallon of water per person per day will suffice for drinking and culinary purposes. Ion-exchange, which is over 99% efficient, is the most practical and economical method of supplying decontaminated water. For immediate demand, small mixed-bed demineralizers, which are easily installed and maintained, are recommended; for long term demand, pressure cation-exchange beds operated on the sodium cycle are recommended. A shelter accommodating 100 people would require a small mixed-bed demineralizer with an initial cost of \$81 and an operating cost of \$9 per day. A pressure cation-exchange bed could be installed for \$7,500 which would have an operating cost of 15 cents per 1,000 gallons. This could supply an average daily water requirement of 50,000 gallons. (auth)

4199 FFIK-IR-K-0215

Norway. Försvarets Forskningsinstitut, Oslo. RADIOCHEMICAL ANALYSIS OF FALLOUT IN NORWAY; Sr^{90} , Sr^{89} AND Cs^{137} IN MILK. H. Bergh, G. Finstad, L. Lund, O. Michelsen, and B. Ottar. May 1959. 9p.

From February 1957 to February 1958 fresh and dry

milk samples were collected throughout Norway and analyzed for strontium-89, strontium-90, and cesium-137. Data are tabulated. (C.H.)

4200 NP-8129

California. Univ., Berkeley. Inst. of Engineering Research.

COMPUTER PROGRAM FOR RANKING VALUES AND DETERMINING PROBABILITY FREQUENCIES OF DOSE AND INTENSITY OBTAINED FROM A MONTE CARLO CALCULATION. R. C. Grassi. Feb. 2, 1959. 32p. Contract CD-SR-58-40.

A program was developed which will give ranked values of dose after an infinite time and ranked values of intensity one hour following burst for a given location (monitoring point). Each value of dose and/or intensity calculated represents the fallout received from a Monte Carlo iteration. In addition, the program will calculate the number of values of dose and intensity, respectively, for each throw or iteration, which are above a specified level of radiation. The computing procedure uses a modification of a program previously reported for plotting iso-intensity and iso-dose contours resulting from the effects of radioactive fallout. (auth)

4201 NP-8131

California. Univ., Berkeley. Inst. of Engineering Research.

A SIMPLIFIED TIME-DEPENDENT GAMMA-RAY SPECTRUM FOR FALLOUT. D. J. Doughty and D. C. Kleinecke. Aug. 15, 1959. 26p. Contract CD-SR-58-40.

The gamma radiation emitted by fall-out is a mixture of hundreds of different photon energies whose relative importance changes through time. It is desirable to approximate this spectrum by a simpler spectrum involving fewer photon energies. A simplified spectrum with four photon energies, which closely approximates more detailed spectra, is proposed and illustrated. (auth)

4202 AEC-tr-3886

SOME DATA ON THE NATURE AND PROPERTIES OF RADIOACTIVE FALLOUT RESULTING FROM ATOMIC EXPLOSIONS SINCE 1945. L. Pauling, S. Sakata, S. Tomonaga, J.-P. Vigier, and H. Yukawa. Translated by Gretchen Riese (Los Alamos Scientific Lab.) from *Compt. rend.* 249, 982-4(1959). 5p. JCL.

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 13, as abstract No. 21863.

4203

STRONTIUM-90. Hans Kiefer and R. Maushart (Kernreaktor Bau- und Betriebsgesellschaft m.b.H., Karlsruhe, Ger.). *Hippokrates* 30, 706-9(1959). (In German)

Strontium-90 in fall-out is discussed. The importance of Sr^{90} among the fission products from nuclear tests is outlined and data are given on Sr^{90} on the surface of the ground near Karlsruhe. The rate of Sr^{90} deposition is pointed out, and uptake by man is described using data tabulations. (T.R.H.)

4204

GAMMA-RADIATION FROM DEPOSITED FALL-OUT. D. H. Peirson and L. Salmon (Atomic Energy Research Establishment, Harwell, Berks, Eng.). *Nature* 184, 1678-9(1959) Nov. 28.

The rate of deposition of fission products from nuclear test explosions has increased in the United Kingdom since 1957. This increase is shown in the annual deposition of strontium-90 in rainfall. About two-thirds of the deposition during 1959 was produced by the explosions in the

autumn of 1958. The increase in external gamma radiation exposure due to the deposition of short-lived fission products was calculated. Data were obtained from an analysis of samples of soil, dust, atmosphere, and rainfall. (C.H.)

4205

SOME MEASUREMENTS OF BACKGROUND GAMMA RADIATION IN LEEDS DURING 1955-59. F. W. Spiers (Leeds Univ., Eng.). *Nature* **184**, 1680-2(1959) Nov. 28.

A number of measurements were made in Great Britain between 1955 and 1959 of the total gamma dose rate from deposited fall-out. Over undisturbed grassland a considerable increase in dose rate occurred. Observations in October 1959 show some decrease from the high values reached in May. The decay of the deposited Zirconium-95-niobium-95 fission products caused this decrease. The finding that radioactive deposition is located in the upper layers of undisturbed soil was supported by observations of the gamma dose rate over a small lawn deliberately contaminated with iodine-131 at a level of 40 $\mu\text{C}/\text{sq m}$. It is pointed out that in deriving the population dose a factor for weathering must be introduced as well as factors for shielding. (C.H.)

4206

ACCUMULATION OF RADIOACTIVE IODINE IN THYROID GLANDS SUBSEQUENT TO NUCLEAR WEAPON TESTS AND THE ACCIDENT AT WINDSCALE. Hamish A. Robertson and Ian R. Falconer (Univ. of Aberdeen, Eng.). *Nature* **184**, 1699-1702(1959) Nov. 28.

Changes in thyroïdal content of iodine-131 in grazing animals due to nuclear weapon tests were measured in Great Britain subsequent to nuclear weapons tests and the accident at the Windscale reactor. Values are presented for the iodine-131 content of the thyroid glands of sheep grazing in north-east Scotland from November 1957 to July 1959, deer thyroid glands from Scotland, and human thyroid glands from the London area obtained between December 1958 and March 1959. Factors affecting variations in the values are discussed. (C.H.)

4207

AIR POLLUTION AND RADIOACTIVITY CIRCULATION PROBLEMS. Lester Machta (U. S. Weather Bureau, Washington, D. C.). *Proc. Natl. Acad. Sci. U. S.* **45**, 1672-86(1959) Dec.

The role of meteorology in the study of large-scale air pollution problems is reviewed. Applications of natural and artificial radioactivity in studies on the atmosphere are described. Weather conditions resulting in area-wide air pollution and activities in progress to study them are discussed. The contribution of weapons-created radioactivity to stratospheric radioactivity is analyzed mathematically. (C.H.)

Radiation Effects on Living Tissues

4208 AF-SAM-59-88

School of Aviation Medicine, Brooks AFB, Tex. and Texas. Univ., Austin.

ACCELERATED TUMOR INCIDENCE IN RATS FOLLOWING CHRONIC GAMMA OR NEUTRON EXPOSURES. Quentin L. Hartwig, Robert W. Riess, and Stephen G. Wilson, Jr. May 6, 1959. 9p.

Two groups of female Sprague-Dawley rats were chronically exposed to ionizing radiation. One group was exposed to a total dose of 38 rep of fast neutrons over a period of 138 days; the other to 1,540 r of Co^{60} gamma rays over a

period of 188 days. Irradiated animals and controls were observed for tumor production. All of the surviving rats of the 1,540 r group were sacrificed 613 days following the first exposure. Forty-six per cent of the irradiated rats developed one or more tumors and 18 per cent of the controls had a tumor. Twenty-nine per cent of the mammary tumors in the irradiated animals were malignant compared to 11 per cent in the controls. A similar increase in malignancy existed in the nonmammary tumors. All of the surviving rats of the 38 rep group were sacrificed 420 days following the first exposure. At termination of the experiment, 35 per cent of the irradiated rats had tumors as compared to 10 per cent of the controls. Thirteen per cent of the exposed animals possessed a malignant mammary tumor but none existed in the controls. As outlined in this experiment, it is postulated that ionizing radiation not only accelerates the appearance of tumors but also favors an early appearance of malignant tumors. (auth)

4209 NP-8080

Food and Drug Research Labs., Inc., New York. THE EFFECT OF IRRADIATED FOODS ON SPECIFIC ENZYME LEVELS IN BLOOD. Final Report. Alvin S. Ostashever. [1959?]. 24p. Contract DA-49-007-MD-862.

Rats fed diets containing irradiated pork, shrimp, green beans, and bread displayed normal growth. The activity of five blood enzyme systems was assayed after 12 weeks on the irradiated diet and found to be normal. (C.H.)

4210 NP-8107

Virginia. Agricultural Experiment Station, Blacksburg. LONG-TERM DOG-FEEDING OF IRRADIATED AND CONTROL SHRIMP AND CARROTS (PHASE 1) AND NUTRITIVE VALUE OF IRRADIATED AND CONTROL PROTEINS (PHASE 2). Progress Report No. 5 for 6-month period ending September 15, 1959. R. W. Engel and D. F. Watson. 10p. Contract DA-49-007-MD-784.

Data are tabulated from a long-term study of the effects of a diet containing irradiated shrimp and carrots on reproduction, body weight, and hematological measurements in dogs. Data are included on the effects of a diet containing irradiated proteins on the growth of rats. (C.H.)

4211 NP-8117

Medical Coll. of Virginia, Richmond. LONG-TERM DOG FEEDING TESTS ON IRRADIATED GREEN BEANS AND FRUIT COMPOTE. Progress Report No. 5 [for] March 16, 1959 to September 15, 1959. Paul S. Larson, H. B. Haag, J. K. Finnegan, R. Blackwell Smith, Jr., Gordon R. Hennigar, Lester F. Belter, and Edwin M. Crawford. 28p. Contract DA-49-007-MD-786.

Data are tabulated on the physical condition of dogs maintained for various periods up to 30 weeks on a diet containing irradiated green beans and fruit compote. (C.H.)

4212 NP-8118

California. Univ., Los Angeles. EFFECT OF IONIZING RADIATION ON THE NUTRITIVE AND SAFETY CHARACTERISTICS OF FOODS. Final Progress Report [for] March 15, 1959-September 15, 1959. J. F. Mead and W. H. Griffith. 22p. Contract DA-49-007-MD-579.

Data are tabulated on the weight gain, food consumption, and food efficiency of the 4th generation of rats maintained on a diet containing irradiated bacon and fruit compote. (C.H.)

4213 NP-8119

Medical Coll. of Virginia, Richmond. MECHANISM OF THE HEMORRHAGIC PHENOMENON

PRODUCED IN MALE RATS BY FEEDING OF IRRADIATED BEEF. Progress Report No. 3 [for] March 15, 1959 to September 15, 1959. Susan J. Mellette and Louis A. Leone. 23p. Contract DA-49-007-MD-951.

Results are summarized from a study of the hemorrhagic phenomena observed in male rats maintained for long periods on a diet containing irradiated beef. The effect of vitamin E levels on the symptoms were studied. (C.H.)

4214 NP-8120

Illinois. Univ., Chicago. Coll. of Medicine.

POSSIBLE CARCINOGENICITY OF IRRADIATED FOODS. Progress Report [for] March 15, 1959 to October 15, 1959. Harry Monsen. 5p. Contract DA-49-007-MD-794.

Preliminary results are summarized from a long-term study on the possible carcinogenicity in rats of a diet composed of irradiated pork loin, chicken, evaporated milk, blanched carrots, and white potatoes. (C.H.)

4215 NP-8121

Johns Hopkins Univ., Baltimore. McCollum-Pratt Inst. EFFECTS OF HIGH LEVELS OF IONIZING RADIATION ON ANIMAL TISSUES. Progress Report XI [for] April 1-August 31, 1959. Kenneth J. Monty. 5p. Contract DA-49-007-MD-631.

Progress is reported in studies on the effects of high-level ionizing radiation on animal tissues. Data are included from an evaluation of the effects of carbonyl compounds formed during the irradiation of meats on physiological and metabolic processes in dogs. A retarded absorption of irradiated lipids was demonstrated. (C.H.)

4216 NP-8122

[Army Medical Research and Nutrition Lab., Denver].

WHOLESDOMENESS OF GAMMA IRRADIATED FOODS. A RÉSUMÉ OF SIGNIFICANT FINDINGS BY SGO CONTRACTORS. Period [covered:] March 15-September 15, 1959. 3p.

Progress is reported in studies on the effects of long-term maintenance on a diet of irradiated bacon, fruit compote, peaches, chicken, green beans, sweet potatoes, cod fish, and evaporated milk on rats; the carcinogenicity of irradiated bacon lipids in mice; and the pyridoxine content of irradiated beef liver, green beans, cabbage, and chicken. (C.H.)

4217 NP-8123

California. Univ., Los Angeles.

THE INFLUENCE OF IRRADIATED LIPIDS ON THE INCIDENCE OF SPONTANEOUS MAMMARY CARCINOMA AND HEPATOMA IN STRAIN A/He AND C₃H MICE. Progress Report No. 4 [for] Period: March 15-September 15, 1959. Ralph W. McKee and Louis J. Zeldis. 4p. Contract DA-49-007-MD-579.

Results are reported on the incidence of spontaneous mammary carcinoma and hepatoma in mice maintained for 20 months on a diet containing irradiated bacon. (C.H.)

4218 JPERS-L-1074-N

ELECTROPHYSIOLOGICAL STUDY OF THE EFFECT OF IONIZING RADIATION ON THE FUNCTIONAL CONDITION OF THE CEREBRAL CORTEX UNDER NORMAL AND PATHOLOGICAL CONDITIONS. T. A. Korol'kova. Translated from *Trudy Inst. Vysshei Nervnoi Deyatel'nosti, Ser. Fiziol.* 3, 121-35(1959). 24p. OTS.

Results are summarized from a series of experiments on rabbits on the effects of single whole-body x-ray exposures at various doses on the function of the cerebral cortex under normal and pathological conditions. (C.H.)

4219 NP-tr-301

ROENTGEN CARCINOMA OF THE RAT TAIL. Ernst

Stutz and Ursula Blüthgen. (National Institutes of Health) from *Strahlentherapie* 105, 278-95(1958). 40p.

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 12, as abstract No. 6400.

4220

ON THE EFFECT OF IONIZING RADIATIONS ON CYANOCOBALAMIN. Monica Sjöstedt and L. E. Ericson (Royal Inst. of Tech., Stockholm). *Acta Chem. Scand.* 13, 1711-12 (1959). (In English)

Solutions of cyanocobalamin in a phosphate buffer of pH 5 were irradiated with doses of 2, 5, and 10 Mrad. Concomitant with a decrease in absorption maxima following irradiation was a tendency for the peaks in the 360 to 550 mμ regions to shift towards lower wave-lengths. Calculations indicated that 60% of the vitamin originally present was destroyed by a 2 Mrad dose at 361 mμ and according to microbiological assay ~85% was inactivated at 2 Mrad. Paper electrophoresis revealed the presence of at least four compounds in the irradiated solutions which could support the growth of *E. coli* 113-3. (C.J.G.)

4221

EARLY CHANGES IN THE LENS EPITHELIUM AFTER ROENTGEN IRRADIATION. A CORRELATED LIGHT AND ELECTRON MICROSCOPIC STUDY. Theodor Wanko, Ludwig von Sallmann, and Mary Ann Gavin (National Institutes of Health, Bethesda, Md.). *A.M.A. Arch. Ophthalmol.* 62, 977-84(1959) Dec.

The eyes of young albino rabbits were irradiated with 1,500 r x rays. The lens epithelium was examined 1, 4, 10, and 14 days after the treatment with the light microscope, in the form of Feulgen-stained flat mounts and with the electron microscope. Cells affected by ionizing radiation are randomly distributed throughout the epithelium but are more numerous in the equatorial zone. The changes occur in all cell constituents except the Golgi complex and range from slight alterations of the individual components to partial disintegration of the whole cell. The lesions gradually increase with time after irradiation in extent and in the number of structural elements involved. Changes in the organization of nuclei, nucleoli, mitochondria, endoplasmic reticulum, cell membranes, and the fine, low-density components are described in detail and correlated with the data resulting from the Feulgen reaction. (auth)

4222

EXPERIENCE WITH THE MASSACHUSETTS CODE ON IONIZING RADIATION. Harold Bavley and Robert L. Devlin (Massachusetts Dept. of Labor and Industries, Boston). *Am. Ind. Hyg. Assoc. J.* 20, 473-7(1959) Dec.

Rules and regulations for the protection of employees exposed to ionizing radiation were adopted by the Massachusetts Legislature in December, 1957. Experiences with the code over a two-year period are reviewed. (C.H.)

4223

RADIATION MYELITIS. John B. Dynes and Magnus I. Smedal (Lahey Clinic, Boston). *Am. J. Roentgenol., Radium Therapy Nuclear Med.* 83, 78-87(1960) Jan.

A review is presented of 10 cases of myelitis which developed following supervoltage therapy of malignant neoplasms. (C.H.)

4224

RADIATION NEPHRITIS. REVIEW, CASE REPORT AND ANIMAL STUDY. Bryan L. Redd, Jr. (Emory Univ. School of Medicine, Atlanta). *Am. J. Roentgenol., Radium Therapy Nuclear Med.* 83, 88-106(1960) Jan.

The literature on radiation nephritis is reviewed. Radiation nephritis may be produced in several experimental animals with numerous different irradiation techniques.

Some 63 cases of radiation nephritis have been recorded in the literature. Another clinical case suggestive of radiation nephritis is presented. Radiation nephritis may develop when both kidneys receive irradiation in excess of 2,500 r tissue dose in five weeks. Radiation nephritis can be avoided in most cases by more careful arrangement of treatment areas. 80 references. (auth)

4225

THE EFFECTS OF ONE CURIE OF SULFUR 35 ADMINISTERED INTRAVENOUSLY AS SULFATE TO A MAN WITH ADVANCED CHONDROSARCOMA. J. Robert Andrews, Richard L. Swarm, Lawrence Schlachter, Kirkland C. Brace, Philip Rubin, Delbert M. Bergenstal, Hazel Gump, Sidney Siegel, and Robert W. Swain (National Cancer Inst., Bethesda, Md.). Am. J. Roentgenol., Radium Therapy Nuclear Med. 83, 123-34(1960) Jan.

Sulfur-35 is deposited in relatively high concentration in viable areas of human chondrosarcoma and is retained there for an extended period of time. The critical tissue for S^{35} appears to be the bone marrow. An intravenously administered dose of 1 curie of S^{35} given in three increments over a period of twenty-four days effected a severe depression of hematopoiesis. Marked depression in the number of circulating platelets was correlated with the presence of S^{35} in the megakaryocytes and in the circulating platelets. An intravenously administered dose of 1 curie of S^{35} given in three increments over a period of twenty-four days may effect temporary cessation of growth of chondrosarcoma. The human dosimetry of large intravenous doses of S^{35} has been developed. (auth)

4226

SARCOMA FOLLOWING RADIATION INJURY OF SKULL. Antolin Raventos and Eugene P. Pendergrass (Univ. of Pennsylvania); and Sidney W. Gross (Mount Sinai Hospital, New York). Am. J. Roentgenol., Radium Therapy Nuclear Med. 83, 145-8(1960) Jan.

Osteolytic areas of the calvarium occur as a rare complication of roentgen treatment of intracranial lesions. Observed roentgenographically, these areas have sometimes been considered as being due to radiation necrosis, but may represent a process of resorption of bone without actual necrosis. In itself, this condition does not appear to be serious. The patient reported here developed a fatal sarcoma of the bone or adjacent soft tissue several years after such areas had been recognized. It is interesting that, although osteolytic areas of bone are well known as a complication of roentgen therapy, we were unable to find any other reported cases in which a sarcoma developed subsequent to the observation of such areas. Present evidence does not permit a conclusion as to whether radiation induced sarcomata most often arise in bone which has undergone post-irradiation resorption, or in areas of less severely damaged bone, or in the soft tissue adjacent to the bone. (auth)

4227

TECHNIQUES FOR THE INTRACAVITARY TREATMENT OF BLADDER NEOPLASMS WITH RADIOACTIVE SOLUTIONS CONTAINED IN A RUBBER BALLOON. G. M. Dyche and N. R. Mackay (Royal Cancer Hospital, London and Royal Marsden Hospital, London). Brit. J. Radiol. 32, 752-6(1959) Nov.

The techniques used at the Royal Marsden Hospital for the intracavitary irradiation of the bladder with radioactive fluids are reviewed. A modification of one of these techniques introduced in an attempt to lower the incidence of irradiation-produced damage is described. A solution of calcium bromide-82 contained in a latex rubber balloon is

used to treat the bladder mucosa continuously for 96 hours, a surface γ dose of 4,200 rads and β dose of 1,000 rads being delivered. The dose-rates are at least ten times less than those used in previous techniques. The results from this treatment for a series of 20 patients are compared with those from earlier techniques. No high dose effects were observed and complete disappearance of all tumors occurred after three months in nine cases. Survival times for the different treatment techniques are tabulated. The method of calculating the radiation dose to the bladder mucosa is outlined. (auth)

4229

STUDIES ON THE PATHOGENESIS OF NEOPLASMS BY IONIZING RADIATION. II. NEOPLASMS OF ENDOCRINE ORGANS. Nechama Haran-Ghera, Jacob Furth, Rita F. Buffett, and Kenjiro Yokoro (Children's Cancer Research Foundation, Boston; Harvard Medical School, Boston; and New England Deaconess Hospital, Boston). Cancer Research 19, 1181-7(1959) Dec.

In an analysis of the pathogenesis of neoplasms of endocrine organs occurring in mice exposed to an experimental atomic detonation, groups of 109 to 140 mice were irradiated with fission neutrons or x rays over the entire body. Some groups were partially shielded; others were subjected to endocrine stresses. Total-body neutron exposure caused thyroid tumors in 3.4 and 7.3 per cent of mice; none was found in total-body x-rayed mice. Thyroid tumors were found in irradiated adrenalectomized and gonadectomized mice; none was found in unirradiated, bilaterally adrenalectomized animals. A high incidence of thyroid tumors occurred in head-neck-irradiated mice. Both adrenal cortical adenomas and chromaffinomas were induced by total-body neutron irradiation and none was seen in similarly x-rayed mice and unirradiated controls. The incidence of ovarian tumors in the total-body neutron or x-rayed groups was not diminished by shielding the upper half of the body. The ovarian tumor incidence was not appreciably raised by isolated head and neck irradiation. It is concluded that neutrons have a high relative biological effectiveness in relation to x rays or γ rays for thyroid and adrenal tumor induction. With respect to ovarian tumorigenesis, it is postulated, on the basis of present data and those of earlier investigators, that the irradiated ovary is unable to respond to homeostatic forces with resultant sustained increase in gonadotropins. (auth)

4229

MODIFICATION OF THE RADIATION RESPONSE DETERMINED BY SINGLE-CELL TECHNIQS: ACTINOMYCIN D. Robert E. Bases (National Institutes of Health, Bethesda, Md.). Cancer Research 19, 1223-9(1959) Dec.

Actinomycin D enhanced the killing effect of x rays on single HeLa cells exposed to the drug just before or after irradiation and during clone formation. Cells irradiated in medium having 85 per cent of the water replaced by D_2O were made more sensitive. Such medium alone sterilized HeLa cells upon progressive exposure. Survivors of D_2O exposure were abnormally sensitive to subsequent irradiation. HeLa cells whose x-ray dose-response curves display hit numbers as high as 10 are reported. (auth)

4230

THE AVERAGE EFFECT OF RADIATION-INDUCED MUTATIONS ON VIABILITY IN DROSOPHILA MELANOGASTER. Bruce Wallace (Biological Lab., Cold Springs Harbor, N. Y.). Evolution 12, 532-56(1958) Dec.

The effects of new radiation-induced mutations in heterozygous condition on the viability of otherwise homo-

zygous individuals were investigated in populations of *Drosophila melanogaster*. Data are tabulated and results discussed. (C.H.)

4231

PRODUCTION OF PHAGE T 3 IN CELLS OF *ESCHERICHIA COLI* B IRRADIATED WITH X-RAYS. F. Herčík (Czechoslovak Academy of Sciences, Brno). *Folia Biol. (Prague)* 5, 328-32(1959).

Inactivation of the capacity of *Escherichia coli* B for phage T 3 by the action of soft x rays was measured. Immediately after irradiation the course of inactivation was approximately linear, with a tendency to diminish after large doses. After 24 hours the inactivation curve of capacity was always biphasic in character; after small doses, rapid inactivation occurred, while after large doses it was conspicuously slower. Two possible explanations of this phenomenon are discussed. (auth)

4232

ATTEMPT TO INCREASE DNA SYNTHESIS IN IRRADIATED BONE MARROW BY MEANS OF NONCELLULAR EXTRACTS AND PYRIMIDINE DEOXYRIBONUCLEOTIDES. V. Drážil, J. Soska, and L. Beneš (Czechoslovak Academy of Sciences, Brno). *Folia Biol. (Prague)* 5, 334-40(1959).

The effect of embryonal extracts and pyrimidine deoxyribonucleotides on DNA synthesis in bone marrow from irradiated animals was studied. The results showed that DNA synthesis in irradiated marrow can be stimulated by embryonal extraction and by the fraction bound by anion exchanger in the formate cycle. The basic fraction was ineffective. The addition of deoxyribonucleotides also increased DNA synthesis. Deoxycytidylic acid had a more pronounced effect, under the same conditions, than thymidylic acid. The increase in DNA synthesis in irradiated bone marrow suspensions was dependent on the concentration of deoxycytidylic acid, the optimal concentration being 30 μ l/ml suspension. Only ribocytidylic acid and ATP had a discernible effect in unirradiated marrow. Embryonal extracts and pyrimidine deoxyribonucleotides influenced DNA synthesis in unirradiated marrow far less than in irradiated marrow. High concentrations of pyrimidine deoxyribonucleotides discernibly inhibited DNA synthesis in unirradiated marrow. (auth)

4233

RESPIRATORY METABOLISM IN RATS DURING IRRADIATION. A. Vacek (Czechoslovak Academy of Sciences, Brno). *Folia Biol. (Prague)* 5, 342-6(1959).

The course of respiratory gaseous exchange in rats during irradiation at different dose rates was studied. After an initial increase, oxygen consumption underwent no further changes during irradiation. A highly significant decrease in the respiratory quotient was observed in irradiated rats, indicative of metabolic changes caused by radiation during actual irradiation. No correlation was found between the total dose and changes in the respiratory quotient. (auth)

4234

THE EFFECT OF A LOW TEMPERATURE ON THE DEVELOPMENT OF RADIATION INJURY IN FROGS.

M. Praslička and M. Hill (Comenius Univ., Košice and Czechoslovak Academy of Sciences, Brno). *Folia Biol. (Prague)* 5, 348-54(1959).

Frogs of the species *Rana esculenta* were irradiated with a dose of 10,000 r and were then kept at room temperature or at a low temperature. Control frogs kept at room temperature died within 17 days after irradiation. Of frogs kept at 4°C only 35% died within 60 days after irradiation,

while the rest died within 12 days when transferred to room temperature. The average weight of the spleens of frogs kept in the cold after irradiation was almost twice that of the spleens of frogs kept at room temperature. Histological examination showed that the reticular cells of the spleens of frogs kept in the cold temporarily maintained the capacity for differentiation into blast cells, which afterwards underwent secondary disintegration. The authors assume that prolonged survival at a low temperature is not due to a lower degree of post-irradiation destruction, but to the maintenance of some degree of ribonucleic acid and protein metabolism. (auth)

4235

NOTES ON THE PROBLEM OF THE FAVOURABLE EFFECT OF INDUCED ANAEMIA ON REGENERATION OF ERYTHROPOIESIS IN THE BONE MARROW OF IRRADIATED RATS. L. Tkadleček (Czechoslovak Academy of Sciences, Brno). *Folia Biol. (Prague)* 5, 356-60(1959).

Inhibition of hematopoiesis in rats irradiated with a dose of 325 r was manifested by a decrease in the absolute number of nucleated elements in the bone marrow. Changes in erythropoiesis occurred sooner than changes in leucopoiesis; reticular cells were also radiosensitive. Anaemia induced immediately after irradiation did not shorten the period of inhibition of haematopoiesis, but after the beginning of regeneration it stimulated the recovery of erythropoiesis, leucopoiesis and reticular cells as compared with the controls. Anaemia lasting for only one day after irradiation or not induced until 24 hours after irradiation was ineffective. (auth)

4236

RADIOLOGICAL STUDY OF WHEAT MONOSOMICS. I. DIFFERENTIAL SENSITIVITY OF MONOSOMIC X AND THE DISOMIC TO X-IRRADIATION. Koichiro Tsunewaki and E. G. Heyne (Kansas State Univ., Manhattan). *Genetics* 44, 933-46(1959) Sept.

A new approach to radiation plant genetics is described which involves the analyses of differential sensitivity of a series of aneuploids to x irradiation. Differential dosage of a specific chromosome may be reflected in differential radiosensitivity of the aneuploid and the disomics. Differential dosage of a group of genes located on the specific chromosome may result in a differential frequency of specific mutants in the X_1 generation. Data are included from a study of radiation responses of monosomic X and disomics of *Triticum aestivum* after irradiation of dormant seeds with a wide range of x-ray dosages. (C.H.)

4237

RADIOLOGICAL STUDY OF WHEAT MONOSOMICS. II. DIFFERENTIAL SENSITIVITY OF 16 MONOSOMICS AND THE DISOMIC TO A SINGLE DOSAGE OF X-IRRADIATION. Koichiro Tsunewaki and E. G. Heyne (Kansas State Univ., Manhattan). *Genetics* 44, 947-54(1959) Sept.

Comparative studies were made on the radiosensitivity of disomic and selfed progenies of 16 monosomics of hexaploid wheat at three stages of development after irradiation of dormant seeds with 14 kr units of x radiation. Data are presented graphically and results discussed. (C.H.)

4238

THE RELATIONSHIP BETWEEN RADIATION DOSE AND DOMINANT VISIBLE MUTATION RATE IN *DROSOPHILA MELANOGASTER*. P. T. Ives (Amherst Coll., Mass.). *Genetics* 44, 967-78(1959) Sept.

Tests were made of the frequency of easily seen visible mutations, chiefly autosomal dominants, of *Drosophila melanogaster* induced at ten radiation dosage levels in the

0.5 to 10 kr range. Results are related to findings in sex-linked lethal tests. (C.H.)

4239

ACUTE γ -IRRADIATION AND BARLEY DEVELOPMENT. Thorsten Hermelin (Inst. of Plant Systematics and Genetics, Uppsala). *Kgl. Lantbruks-Högskol. Ann.* 25, 327-39 (1959).

During the years 1956, 1957, and 1958 barley plants were exposed to acute gamma-irradiation from a Co^{60} source. The irradiations have been carried out under different parts of the vegetation period. The first treatment was applied premeiotically, the next during the time of meiosis, and thereafter up to the beginning of endosperm formation. The experiments have been planned in such a manner that it has been possible to compare different intensities of radiation. Throughout the experiments, presented here, there is a marked difference in sensitivity between treatments at different stages of development. An increased sensitivity is displayed at meiosis with doses < 1000 r. Differences between different intensities of radiation appear in the experiments of 1956 and 1957, where these effects were studied. In the presented results it seems as if the effects were not as distinct after treatment under long time as after treatment with the same dosage under an essentially shorter time. (auth)

4240

CERTAIN HISTOCHEMICAL STUDIES OF BLOOD CELLS IN ACUTE RADIATION SICKNESS. V. A. Gubin. *Med. Radiol.* 4, No. 10, 3-8(1959) Oct. (In Russian)

Results are presented from histochemical investigations of the content of oxidase, peroxidase, alkaline phosphatase, and glycogen in the blood leukocytes of rabbits subjected to the action of x irradiation in doses of 400, 800, and 1,500 r. The irradiation provokes a noticeable rise in the level of glycogen and a decrease of the phosphatase activity in the neutrophils. These changes are revealed from the first hours after the irradiation. The drop of oxidase and peroxidase activity was less marked. With the radiation sickness progressing, the above changes, as a rule, intensified and usually were greater with the high irradiation. Reduction of the enzyme activity in the peripheral blood leukocytes was evidently caused by the disturbance of the processes of cell maturation in the hemopoietic centers and their entrance into the blood. (auth)

4241

PERMEABILITY CHANGES OF VASCULAR BARRIERS IN THE ACTION OF IONIZING RADIATION ON THE ORGANISM. N. V. Butomo. *Med. Radiol.* 4, No. 10, 9-13(1959) Oct. (In Russian)

The author studied the permeability of vessels of the hemato-ophthalmic barrier following total irradiation of rabbits and dogs. A considerable increase of vascular permeability in respect to blood proteins was seen at early periods after irradiation. Consequently, throughout the course of radiation sickness there were noted fluctuations of the permeability level, with an ultimate rise. (auth)

4242

THE INFLUENCE OF LOCAL X-RAY IRRADIATION ON THE CONTENT OF ACID-INSOLUBLE PHOSPHORUS FRACTIONS IN THE BONE MARROW OF RABBITS AND THE RATE OF RADIOPHOSPHORUS INCLUSION. V. S. Turovskii. *Med. Radiol.* 4, No. 10, 17-21(1959) Oct. (In Russian)

The author studied the content of acid-insoluble phosphorus fractions and the rate of radiophosphorus inclusion in the bone marrow of rabbits. Under analysis was the

bone marrow of rabbit's lower extremities. One of the latter was subjected to irradiation in the dose of 500 r. The results obtained were compared with similar indices from healthy non-irradiated rabbits. In the bone marrow subjected to the direct action of irradiation the content of acid-insoluble phosphorus fractions and the rate of radiophosphorus inclusion at the beginning sharply dropped, but towards the end of the observation (32nd day) these indices reverted to normal or were somewhat higher. The bone marrow subjected to a reflected action of irradiation was characterized at the end of the observation by a considerable rise in the content of acid-insoluble phosphorus fractions, especially the fraction of nucleic acids. (auth)

4243

ON THE EARLY AND LATE CHANGES IN THE SKELETAL MUSCULATURE OF RATS SUBJECTED TO THE LOCAL ACTION OF X-RAY IRRADIATION. T. N. Tuzhilkova. *Med. Radiol.* 4, 34-7(1959) Oct. (In Russian)

Results are presented from studies of the local action of 3,000 r x rays on the muscular tissue. The anterior tibial muscle of white rats was the object of investigation. The radiation injury of the muscle can be detected soon after the irradiation and is characterized by a stable inhibition of the regeneration capacity of the muscular tissue. A marked tendency to regeneration appears in the affected muscular tissue only in one year following the irradiation. At this time there could be observed in the muscle an acute atrophy, which develops gradually and becomes distinct from the 6th to 8th month after the irradiation. (auth)

4244

THE EFFECT OF X-RAY IRRADIATION ON THE COURSE OF VACCINAL PROCESS CAUSED BY THE ADMINISTRATION OF LIVING BRUCellosis VACCINE TO ANIMALS. Z. V. Shevtsova. *Med. Radiol.* 4, No. 10, 46-53(1959) Oct. (In Russian)

Investigations were conducted on white rats irradiated at doses of 300 to 600 r and guinea pigs irradiated at doses of 150 to 250 r. It appeared that immunization with vaccinal brucella culture at the height of radiation sickness increases the death rate of the irradiated animals. As demonstrated by bacteriological examination, development of generalized vaccinal process in the irradiated and immunized animals pursued the same course as in the immunized non-irradiated animals. This process was manifested in the dissemination of brucella vaccinal strain in various organs. However the irradiated animals become cleared of the vaccinal culture at a somewhat slower rate than in the non-irradiated ones. In guinea pigs, irradiated previous to vaccination there was a slower formation of agglutinins with lower titre than in control non-irradiated animals. Opsonic phagocytic blood index was somewhat lower only in the animals irradiated 24 hours previous to the vaccination. When irradiating white rats 24 hours or 10 days in advance or 24 hours after the vaccination, a delay in the agglutinin production has been observed during the first days following the vaccination. (auth)

4245

X-RAY IRRADIATION DOSES TO WHICH THE PATIENTS AND THE MEDICAL PERSONNEL ARE EXPOSED IN CARDIAC CATHETERIZATION. K. Durcek, F. Minarik, A. Stankovicova, M. Petrasova, and L. Uricek. *Med. Radiol.* 4, No. 10, 66-70(1959) Oct. (In Russian)

The x-ray doses were determined to which the patients and the medical personnel were exposed in cardiac catheterization. The authors studied the distribution of second-

ary irradiation around the x-ray unit with the aid of the method involving curves of equal intensity and also investigated the dependence of the irradiation level on various factors, i.e., the x-ray tube voltage, the field area on the screen, external filtration, and the patient's position. A conclusion was arrived at that cardiac catheterization cannot be regarded as the usual type of roentgenological examination due to the high x-ray irradiation doses to which the patient and the medical personnel are exposed. The simplest methods of reducing these doses are described. (auth)

4246

A NEW APPROACH TO THE MECHANISM OF MUTATIONS. Paul Mandel and Pierre Chambon (Institut de Chimie Biologique, Strasbourg). Nature 184, Suppl. No. 19, 1501-12(1959) Nov. 7.

Data concerning the mechanism by which x rays block the biosynthesis of nucleic acid led to the postulation of a hypothesis on the origin of mutations induced by x radiation, which may also explain spontaneous mutations. This hypothesis is discussed. (C.H.)

4247

EFFECT OF X-RADIATION ON THE SURVIVAL OF YEAST IN DRY AND WET CONDITIONS. A. Mookerjee (Saha of Nuclear Physics, Calcutta). Nature 184, Suppl. No. 19, 1502-03(1959) Nov. 7.

The effects of both direct and indirect actions of ionizing radiations on yeast cells were measured by irradiating the material in both the dry and wet state. Results show a considerable difference between cells irradiated in the dry state and those held in suspension in water. Results are presented graphically. (C.H.)

4248

WANTAGE INDUSTRIAL IRRADIATION FACILITIES. COMMERCIAL APPLICATIONS. Nuclear Energy Engr. 13, 593-5(1959) Dec.

The irradiation facilities at Wantage for sterilizing industrial and medical products are described. (C.J.G.)

4249

COMPARATIVE STUDY OF THE LETHAL EFFECTS OF COBALT-60 GAMMA RAYS AND 200 kv X RAYS ON C-57 MICE. Roger Ghys (Royal Cancer Hospital, London). Oncologia 12, 279-94(1959). (In French)

The lethal effects of 200 kv x rays and gamma radiation from a cobalt-60 source were compared for mice. Factors affecting the radiosensitivity of mice are discussed. (C.H.)

4250

THE INFLUENCE OF PROLONGED LOW-INTENSITY PENETRATING RADIATION ON CONDITIONED AND UNCONDITIONED REFLEXES. O. P. Iaroslavl'tseva (Academy of Medical Sciences, USSR). Pavlov J. Higher Nervous Activity (U.S.S.R.) (English Translation) 8, 616-23(1958) Oct.

Single 10 r doses of general irradiation, applied at short or long intervals or practically without intervals, with a total dose of 30 r, caused non-persistent changes in an elaborated system of conditioned and unconditioned reflexes. These changes increased for some time even after the end of the irradiation. Further repeated irradiations with doses of 10 r led to a considerable weakening of the inhibitory process, in consequence of which the stability of the magnitudes of conditioned and unconditioned reflexes was destroyed and the phenomenon of explosiveness in the excitatory process was observed. After cessation of the irradiation, instability of cortical activity to slight changes in the usual experimental setting continued for a considerable time. (auth)

4251

RADIATION FROM ARTIFICIAL RADIOACTIVE MATERIALS AND ITS IMPORTANCE IN CARCINOGENESIS. E. Ia. Smolovskaia (Academy of Medical Sciences, USSR). Problems of Oncol. (USSR) (English Translation) 5, 44-52(1959) Sept.

By the use of insoluble radioactive preparations of Co^{60} Ag^{110} , and W^{185} , in amounts of the order of 100 μc , we obtained tumors of the mammary glands in 10 of 32 female rats which survived for 6 months from the beginning of the experiment. Of these tumors eight were adenocarcinomata and two sarcomata. The γ -rays from Co^{60} were most effective in the induction of adenocarcinomata of the mammary glands. The doses required were several tens of thousands rads per centimeter cubed, which can be regarded as threshold doses. A far smaller yield of tumors was observed as a result of the action of mixed β - and γ -radiation from Ag^{110} , used without filters. In a series of 16 rats tumors were observed in only four. On account of the predominance of β -rays, the doses reached several tens of millions of rads per centimeter cubed, and were several hundred times higher than the threshold doses. By the use of excessively small amounts of isotopes, and hence with small doses of absorbed energy, it was not possible to obtain tumors. No tumors were found in control animals. (auth)

4252

FIRST RESEARCH ON THE DOMINANT LETHALS INDUCED WITH X-RAYS ON THE MALES OF LOCUSTA MIGRATORIA MIGRATORIOIDES R. AND F. (ORTHOPTERA). Giuseppe Colombo (Università di Padova). Ricerca sci. 29, 2133-41(1959) Oct. (In Italian)

Males of *Locusta migratoria migratorioides* R. and F. at 4th instar, just after the last moult and a month after the last moult were irradiated with x rays from 50 to 1600 roentgens. The irradiated males were mated to non-irradiated virgin females and the offspring was scored for embryo mortality. In this way dominant lethals induced in spermatogonia, spermatocytes and sperms were studied. The relation dosage-effects, for dominant lethals induced on sperms, follows a one-event curve; but it is possible that doses high enough to produce multi-event effects were not used. The sex ratio was observed to be altered in favor of males. The frequencies of dominant lethals increase when more mature germ cells are irradiated. This result is explained as cell selection against germ cells irradiated in premeiotic and meiotic stages. This view is supported by several experiments on chromosomes and cell damages by x rays on Orthoptera. The percentages of embryos death at different stages of development were determined. When sperms were irradiated there was a higher mortality during segmentation, whereas when spermatogonia were irradiated mortality was higher in later stages of the embryonic development. This result is considered to be further evidence of cell selection against germ cells irradiated during premeiotic stages. (auth)

4253

TOLERANCE OF MOUSE-BRAIN TISSUE TO HIGH-ENERGY DEUTERONS. Wolfgang Zeman (Columbus Psychiatric Inst. and Hospital, Ohio); H. J. Curtis and E. L. Gebhard (Brookhaven National Lab., Upton, N. Y.); and Webb Haymaker (Armed Forces Inst. of Pathology, Washington, D. C.). Science 130, 1760-1(1959) Dec. 25.

A striking relationship between the size of the impact area of a deuteron beam and the threshold dose for a radiogenic lesion has been noted. The dose required to produce a threshold lesion in mouse brain increases

from 30,000 rad with a beam 1000 μ in diameter to 1.1×10^6 rad with a beam 25 μ in diameter. (auth)

4254

THE EFFECT OF X-RAY IRRADIATION ON THE ACTIVE TRANSPORT OF SODIUM AND POTASSIUM AND RESPIRATION OF KIDNEY SLICES. Heinz Breuer and Heinz Karl Parchwitz (Universitätsklinik und -Poliklinik, Bonn). Strahlentherapie **110**, 451-5(1959) Nov. (In German)

The effect of irradiation on the active transport of sodium and potassium and the respiration of kidney cortex slices of male guinea pigs was studied. Thirty minutes after incubation in Krebs-Ringer solution the concentration of potassium was decreased and the concentration of sodium was increased in the irradiated slices as compared with control slices. Under the same conditions an increased tissue respiration was observed. In order to find a possible relation between uncoupling of the oxydative phosphorylation and these observations, unirradiated and irradiated slices were incubated in the presence of dinitrophenol. The results suggest that the radiation induced inhibition of the active transport of sodium and potassium and simultaneous increase of the respiration may be due to changes of the permeability of the cells. (auth)

4255

THE EFFECT OF IONIZING RADIATION OF THE PROGENY IN IRRADIATION OF ANIMALS DURING THE LAST DAYS OF PREGNANCY. E. A. Zulkova, M. Ya. Chalkovskaya, and S. L. Petrosian. Vestnik Rentgenol. i Radiol. **34**, No. 5, 34-41(1959) Sept.-Oct. (In Russian)

The result of investigations demonstrated that a total single irradiation of dogs in a dose of 500 r during the last days of pregnancy leads to the development of acute radiation sickness in newborn puppies and causes their death soon after birth. Radiation sickness in newborn puppies as distinct from adult animals in a number of cases was associated with necrotic lesions of the urinary bladder, atelectasis of the lungs, and cerebral edema. Hemodynamic disturbances of the central nervous system play an important role in the appearance of atelectasis and of the cerebral edema. The course of radiation sickness in dogs irradiated during the last days of pregnancy was comparatively mild. Reaction of peripheral blood to irradiation was short and of peculiar nature. (auth)

4256

GENETICS, RADIOBIOLOGY AND RADIOLOGY PROCEEDINGS, MID-WESTERN CONFERENCE. Wendell G. Scott and Titus Evans. Springfield, Ill., Charles C. Thomas, 1959. 160p.

The mechanisms of radiation damage to living tissue are reviewed. The genetic effects of radiation are discussed. Problems in reducing radiation genetic effects in the medical use of x rays are considered. (C.H.)

Radiation Sickness

4257

SENSITIVITY OF PROTEINS OF THE BONE MARROW OF IRRADIATED ANIMALS TO PROTEOLYTIC ENZYMES. R. Ye. (E.) Libinon and I. A. Tseveleva. Biochemistry (USSR) (English Translation) **24**, 246-8(1959) Mar.-Apr.

Irradiation of rabbits with a 1000 r dose causes a rise of sensitivity of bone marrow proteins to the action of pepsin and trypsin. The increase of enzymic cleavability of the bone marrow proteins, noticeable beginning with the first minutes after irradiation, rises somewhat during the next 12 hours. A second rise of sensitivity of bone-marrow

proteins to the proteolytic enzymes was noted following 6 and 13 days after the action of ionizing radiation. (auth)

4258

EFFECT OF BONE MARROW CULTURE IN VITRO ON ITS PROTECTIVE ACTION IN IRRADIATED MICE. Daniel Billen (Univ. of Texas M. D. Anderson Hospital and Tumor Inst., Houston). J. Natl. Cancer Inst. **23**, 1389-95(1959) Dec.

Mouse bone marrow cells tissue-cultured in a special container have been studied in an attempt to identify the cells responsible for the protection afforded recipient, lethally irradiated mice, by bone marrow post treatment. After 4 days of culture, a decreased protective activity of injected tissue-cultured cells was observed. By the 9th day of life in vitro, the explanted bone marrow cells had essentially lost their protective capacity. Analysis of the cell species present at this time showed that several stem-cell types persisted in such negative cultures. These findings are discussed in relation to the mechanism of protection of recipient mice, with bone marrow. (auth)

4259

DELAYED MORTALITY OF RADIATION CHIMERAS: A PATHOLOGICAL AND HEMATOLOGICAL STUDY. M. J. de Vries and O. Vos (National Health Research Council TNO and National Defense Research Council TNO, Rijswijk Z. H., Netherlands). J. Natl. Cancer Inst. **23**, 1403-39(1959) Dec.

The hematological and pathological changes in lethally x-irradiated mice treated with isologous, homologous, or heterologous (rat) bone marrow are reported. Two different disease entities were observed in mice treated with homologous or heterologous bone marrow. Bone marrow aplasia chiefly occurred before the 30th day after irradiation. This resulted in death from septicemia or hemorrhage. The secondary bone marrow failure is explained by an immunological reaction of the host against the bone marrow graft. After the 30th postirradiation day, the animals were emaciated and had dermatitis, pneumonia, diarrhea caused by focal colitis with crypt degeneration, and necrosis of the liver. The delayed foreign bone marrow reaction is of a complex nature. Impaired recovery of radiation-induced lesions, decreased resistance to bacterial infections, probably due to generalized atrophy of the lymphatic tissues, as well as an immunological reaction of the graft against the host are postulated to be causal factors. An important difference was noted between animals treated with heterologous and those treated with homologous bone marrow. Bone marrow aplasia predominated in the mice of the former group. In contrast, the mice of the latter group were chiefly affected by pneumonia, diarrhea, and colitis. Regeneration of the lymphatic tissues occurred within a month after irradiation in animals treated with isologous bone marrow, but it was retarded or failed to occur in animals treated with foreign bone marrow. The possible relation of the lymphatic-tissue changes to the etiology of the secondary disease is discussed. (auth)

4260

THE CHANGE OF CERTAIN PHYSICO-CHEMICAL PROPERTIES OF BLOOD PLASMA PROTEINS IN ANIMALS DURING ACUTE RADIATION SICKNESS. K. V. Gordeeva and A. S. Mozhukhin. Med. Radiol. **4**, No. 10, 13-17(1959) Oct. (In Russian)

In dogs subjected to x irradiation, at a dose of 400 r, the authors investigated the viscosity, opacity, transparency, surface tension, thermal coagulation, and protective properties of the blood plasma, as well as the aggregation and sedimentation of fibrinogen isolated from

the plasma. At the peak of acute radiation sickness there was noted an increase of the viscosity and prolongation of the time of thermal coagulation of the blood plasma. In the majority of the experiments there was seen an opacity of the plasma, and aggregation and sedimentation of fibrinogen isolated from the plasma studied. The other indices did not show any essential changes after the irradiation of the animals. (auth)

4261

THE EFFECT OF ACTH OF THE HYPOPHYSIS AND THE SUPRARENAL CORTEX EXTRACT ON THE HEMATOPOIESIS OF IRRADIATED ANIMALS. M. F. Aleksandrova. *Med. Radiol.* 4, No. 10, 21-6(1959) Oct. (In Russian)

The author's investigations on 186 male rats demonstrated that preparations of ACTH and the suprarenal cortex extract possess a higher activity and induce distinct changes of hematopoiesis in intact rats. The action of the preparations referred to on the hematopoiesis of intact and irradiated rats is different. In animals subjected to a single irradiation the injections of ACTH from the first day following irradiation reduced the severity of hematopoietic affection. The influence of the suprarenal cortex extract on the irradiated rats was slight. (auth)

4262

THE STUDY OF THE PROPERTIES OF ERYTHROCYTES BY THE METHOD OF STRICTION. Yu. A. Kriger and E. I. Yartsev. *Med. Radiol.* 4, No. 10, 26-30(1959) Oct. (In Russian)

With the aid of the toxicometric method, elaborated by B. N. Tarusov, the possibility of formation of toxic products in the irradiated biosubstrate was studied. It was established that when muscular brei is placed into an irradiated suspension of rat's erythrocytes there occurs an inhibition of the striction not attended, however, by the appearance of peaks on the experimental curve. The appearance of peaks on the latter, indicating the presence of toxic substances, was recorded only in condition of a one-hour incubation of the biosubstrate carried out immediately after the irradiation. The number and amplitude of peaks rose consecutively after 9.24 and 48 hours following the irradiation with a simultaneous decrease of striction inhibition. After 72 hours there were noted a disappearance of peaks and elimination of striction inhibition. The presence of peaks on the curve when the muscular brei is placed into the suspension serves as a testimony of the transfer into the latter of toxic products, formed upon the irradiation of erythrocytes. The appearance of the toxicity is apparently characteristic only for radiation injury of erythrocytes. It is observed neither in hypotonic hemolysis nor in saponin hemolysis. On the basis of data obtained and on that of previous electron-optic and electrometric investigations a supposition is made on the relation of toxic substances with phospholipids and products of their disintegration, occurring during the action of γ -rays on the erythrocytes. (auth)

4263

BONE CHANGES IN THE POSTNATAL PERIOD IN THE OFFSPRING OF RABBITS SUBJECTED TO THE ACTION OF IONIZING RADIATION AT DIFFERENT TIME PERIODS OF PREGNANCY. E. I. Aleksandrovich. *Med. Radiol.* 4, No. 10, 30-4(1959) Oct. (In Russian)

The investigations performed disclosed that the most pronounced changes in the development of bones in the postnatal period in the offspring of rabbits, subjected to intrauterine irradiation with a single total dose of 300 r, could be noted on the 13th day of pregnancy, rather than on the 20th day following irradiation. These data are

similar in roentgenological and in histological investigations. Changes noted roentgenologically show retardation in the growth of bones lengthwise and delay in the appearance of ossification nuclei in the long bones of the extremities. Histological changes in the same bones of the offspring of rabbits consist of proliferation of bone marrow elements, thickening and swelling of intercerebral septa, reduced blood supply, development of connective tissue, and thinning of intercerebral septa. (auth)

4264

THE TREATMENT OF RADIATION SICKNESS COMPLICATED BY TRAUMATIC SHOCK. I. V. Ilyinskaya and T. N. Astakhova. *Med. Radiol.* 4, No. 10, 38-41(1959) Oct. (In Russian)

The article deals with the study of the course of radiation sickness complicated by mechanical trauma, and its treatment. The results obtained indicate that the injury inflicted to the irradiated animals aggravated the course of radiation sickness and led to the death of all rabbits. When the animals were subjected only to irradiation with a similar dose the death rate comprised 50%, while that following trauma was 30%. Complex treatment of radiation sickness in animals recovered from the condition of shock throughout a course of 21 days effected a survival rate of 90%, whereas the lethality in the control group was 100%. (auth)

4265

THE USE OF VITAMINS B₁₂ AND B₆ IN CONDITIONS OF REPEATED ACTION OF X-RAYS. O. I. Belousova and E. K. Grabovenko. *Med. Radiol.* 4, No. 10, 41-6(1959) Oct. (In Russian)

The authors present the results of a study on the efficacy of vitamins B₁₂ and B₆ in subacute radiation sickness induced by daily irradiation of dogs in the dose of 20 r with the total dose 500 r. The experiments were staged on 35 dogs. The use of vitamins B₁₂ and B₆ separately and combined did not prevent disturbances of hematopoiesis. However, the inhibition of hematopoiesis, especially erythropoiesis, in dogs receiving the vitamins was less marked. In the treated dogs there was observed a tendency to an earlier normalization of correlation of erythroblastic and myeloid elements in the bone marrow. The content of leukocytes and thrombocytes during 2 to 3 weeks after the cessation of the irradiation was higher than in the control animals. The combined administration of vitamins B₁₂ and B₆ was the most effective. (auth)

4266

THE SPECIFIC FEATURES IN THE COURSE OF AFFECTIONS CAUSED BY THE ACTION OF IONIZING RADIATION AND BURN. A. L. Komendantova, E. A. Kruscheva, K. V. Botsmanov, O. P. Kokorina, and O. A. Yuchenkova. *Med. Radiol.* 4, No. 10, 54-9(1959) Oct.

The authors studied the course of radiation injuries in 62 dogs induced by ionizing radiation in the dose of 400 and 600 r coupled with burns of the 1st and 2nd degree, covering from 2 to 10% of the body surface. The burns were inflicted with the aid of magnesium mixed with barium peroxide. In the untreated animals even insignificant burns sharply deteriorate the course of radiation sickness, caused by ionizing radiation in the dose of 400 r. This deteriorating influence diminishes when the animals are treated with antibiotics, hemostimulants, and vitamins. In large doses of ionizing radiation the deteriorating influence of burns on the course of radiation sickness does not decrease. Mild burns covering up to 10% of the body surface, do not deteriorate the course of radiation sickness when the animals are treated. The focus of inflammation

exerts a stimulating effect on the restoration of the number of leukocytes in the peripheral blood of convalescents, who sustained radiation sickness. (auth)

4267

THE CHANGE OF SENSITIVITY TO VISCERAL INJURY OF ANIMALS WHO HAD SUSTAINED RADIATION SICKNESS. G. Sh. Vasadze and S. G. Sherashev. Med. Radiol. 4, No. 10, 59-66(1959) Oct. (In Russian)

The paper deals with the results of experiments on rabbits who 8 to 9 months following irradiation were subjected to mechanical injury of the intestine until the development of the torpid state of shock. The rabbits with radiation sickness suffered from the trauma to a lesser degree than those who had not sustained the sickness. In order to induce a torpid stage of traumatic shock in the irradiated animals it was necessary to carry out a lesser number of eviscerations, while the life span of these animals following the development of shock was considerably shorter than in the non-irradiated control rabbits. (auth)

4268

RADIOBIOLOGY. RADIOPROTECTIVE ACTION OF METHOXAMINE. A. D. Smith, M. J. Ashwood-Smith, and Doreen Lowman (M.R.C. Radiobiological Research Unit, Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nature 184, Suppl. 22, 1729-30(1959) Nov. 28.

Methoxamine, β -hydroxy, β -(2, 5-dimethoxyphenyl)-iso-propylamine, was found to have a protective effect against radiation injuries mice. (C.H.)

4269

CLINICAL EXPERIENCE WITH THE EFFECT OF PREDNISOLON ON THE GENERAL RADIATION REACTION (X-RAY SICKNESS), ON CHARACTERISTIC HEMATOLOGICAL CHANGES CAUSED BY RADIATION, AND ON TUMOR CACHEXIA. Bernhard Freyer (Rudolf-Virchow-Krankenhauses, Berlin). Strahlentherapie 110, 401-12(1959) Nov. (In German)

In 50 cases the effect of Prednisolon (Deltacortril) on the symptoms of the general radiation reaction and tumor cachexia was studied. Radiation reactions improved quickly after administration of Prednisolon. Radiotherapy patients developed no significant symptoms of general radiation reaction if prophylactic treatment with Prednisolon was given. The effect of Prednisolon could be substantiated by characteristic hematological changes in the irradiated cases. The outstanding effects of Prednisolon in the treatment of tumor cachexia are: euphoria, good effect on neurologic changes caused by tumors or metastases of the central nervous system, and in combination with thyroxin the possibility is given to treat successfully over a period of time far advanced cases of cancer of the breast. The indications for the use of Prednisolon in the field of cancer include symptomatic treatment of radiation reaction and radiation sickness, palliative treatment of far advanced metastasing tumors and tumor cachexia, and additional treatment of neurologic changes caused by tumors or metastases of the central nervous system. (auth)

4270

THE ALPHA RADIATION OF THE HUMAN BODY AND ITS ENVIRONMENT. W. V. Mayneord, J. M. Radley, and R. C. Turner (Royal Marsden Hospital, London). Strahlentherapie 110, 431-42(1959) Nov. (In German)

The natural alpha irradiation of the skeleton is a measure for the danger produced by artificial radioactivity with respect to bone-tumors and leukemia. For the purpose of measuring the natural alpha activity of a large num-

ber of tissue, food, and other samples, the ashed and pulverized material was put into lucite dishes, which were covered on the inside with zinc sulfide and which could be put on a calibrated photomultiplier. The distribution of the thorium group could be determined from the appearance of the quickly consecutive transitions $\text{Th}-220 \rightarrow \text{Th}-\text{A}-216$ and $\text{Th}-\text{A}-216 \rightarrow \text{Th}-\text{B}-212$. The natural alpha activity of tissues showed regional differences, but no correlation with age. Among the foodstuffs certain kinds of nuts and grain products were most active. With the use of Brazil nuts experiments on the incorporation and retention of alpha activity in human beings have been carried out. (auth)

4271

CLINICAL VALUE OF PROTECTIVE MATERIAL AGAINST RADIATION INJURY. Hideo Irie (Kyushu Univ. Medical Coll., Fukuoka). Strahlentherapie 110, 456-61(1959) Nov. (In German)

Chemical radiation protection agents are required for prophylactic purposes against radiation injuries of radiological personnel and radiation patients as well as for healing purposes post irradiation. Vitamin K was tested for both indications in experiments on animals and was successfully tried in clinical prophylactic treatment (daily dose 30 to 100 mg). As a prophylactic, and also against local irradiation, the recently developed ACTH is suitable. However, because of its strong protective effectiveness, it cannot be given to tumor patients. As a healing agent adrenochrome may be useful at daily dose of 10 to 30 mg.

4272

SOME DATA ON ECHINOPSIN ALKALOID TREATMENT OF PATIENTS FOR CHRONIC RADIATION SICKNESS. G. P. Gubina and L. M. Omelyanenko. Vestnik Rentgenol. i Radiol. 34, No. 5, 29-34(1959) Sept.-Oct. (In Russian)

The authors suggest a new method of treating chronic radiation sickness with echinopsin (1% of the nitrate salt), an alkaloid used in this disease for the first time. Forty-two patients with radiation sickness of various duration and gravity were treated with this preparation starting with 5 drops per dose twice a day, and gradually increasing the dose to 10 to 20 drops per dose. The first course of treatment, which required 10 to 12 days was repeated after an interval of 10 to 20 days. The patients' general condition most often showed improvement at the end of the first week with the headaches alleviated, general weakness diminished and the patient feeling stronger and more active. The previously disturbed functions of the peripheral and the central nervous system recovered. Later on these results would become sufficiently stabilized with subsequent restoration of the patient's ability to perform his normal work. Echinopsin treatment may be coupled with vitamin therapy and hemostimulants. This treatment is contraindicated in hyperthyroidism and pronounced overexcitation of the central nervous system. (auth)

CHEMISTRY

General and Miscellaneous

4273 AECU-4493

Tracerlab, Inc., Waltham, Mass.
YEARLY REPORT ON THE DEVELOPMENT OF RADIO-CHEMICAL ANALYZERS FOR NON-RADIOACTIVE GASES AND STUDY OF RADIOACTIVE CLATHRATES. D. J. Chleck, F. J. Brousaides, C. Hommel, W. Sullivan, L. Fishbein, and C. Ziegler. July 1, 1959. 43p. Contract AT(30-1)-2204. OTS.

Design and development of a radiochemical SO_2 monitor is reported. A demonstration model was constructed in addition to a smaller portable prototype monitor. A radiochemical system was investigated which utilizes lithium aluminum tritide as the radioactive salt. The sensitivity and usefulness of this system as both a quantitative and qualitative tool were demonstrated. Quinal-K⁴⁵ clathrate was successfully prepared by the fusion technique. Properties of this compound were investigated and its sensitivity to ozone was demonstrated. Development of a lithium-aluminum hydride system capable of detecting any active hydrogen compound and any hydrocarbon upon combustion is reported. This system in conjunction with the clathrate system allows for the determination of many oxidizing and reducing systems. (J.R.D.)

4274 AERE-M-412

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

THE RADIATION AND THERMAL STABILITY OF SOME POTENTIAL ORGANIC MODERATOR COOLANTS. PART III. THERMAL STABILITY OF PARA-TERPHENYL AND SANTOWAX-R. R. W. Wilkinson and T. H. Bates. Aug. 1959. 28p. BIS.

The thermal decomposition of degassed para-terphenyl and Santowax R was studied at 466, 440, and 420°C, and the nature of the gaseous and condensed products was investigated. In addition to the production of higher polyphenyl compounds and biphenyl in both cases, significant quantities of benzene were found in the products from para-terphenyl. The gas evolved was mainly hydrogen, containing some methane and C_2 hydrocarbons. At 466°C the conversion rates of para-terphenyl and of Santowax R were found to be first order up to 80% decomposition. No carbon formation was observed. The over-all activation energies for polymer production and for hydrogen production from para-terphenyl were each 70 ± 5 k cal/mole. On this basis reactions leading to the production of higher polyphenyl compounds are suggested. Some experiments on the effect of various metals on the decomposition of Santowax R *in vacuo* at 450°C are appended. This work was complementary to that described in AERE M/M 153 and AERE M/M 153A. In the case of the uranium samples, hydrogen gas evolution was considerably lower, as expected from the results described in the above memorandum. The amounts of polymer formed were not appreciably affected. (auth)

4275 AFOSR-TN-59-757

Ohio State Univ. Research Foundation, Columbus. LAUE-BRAGG SCATTERING AND CHARGE DISTRIBUTION IN LITHIUM HYDRIDE. Technical Report 3. Travis J. Phillips and P. M. Harris. Sept. 1959. 45p. Contract AF18(600)-769. RF Project 567.

Intensities of Laue-Bragg scattering from single crystals of LiH were obtained at room temperature and at 100°K using an x-ray spectrometer. Values of relative crystal structure factors, and relative atomic form factors were derived from these values. Absolute crystal structure factors and electron density distributions were computed. Radial charge distributions were computed from the electron density distributions. (J.R.D.)

4276 HW-44987

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

REDUCTION OF PLUTONIUM(VI) WITH HYDROGEN PEROXIDE. M. N. Myers. Aug. 17, 1956. Decl. Nov. 23, 1959. 12p. Contract W-31-109-Eng-52. OTS.

The kinetics of the reduction of Pu(VI) by H_2O_2 in nitric acid was studied. The effect of Fe , H_2O_2 concentration, H^+ concentration, and light on the reaction is reported. (C.J.G.)

4277 LA-2358

Los Alamos Scientific Lab., N. Mex.

THE DENSITY OF LIQUID PLUTONIUM METAL. C. E. Olsen, T. A. Sandenaw, and C. C. Herrick. May 1959. 14p. Contract W-7405-eng-36. OTS.

The product of surface tension (γ) and the contact angle (θ) of liquid plutonium vs. solid tantalum and of the density of liquid plutonium (ρ) as functions of temperature at 655 to 960°C was measured. The values $\gamma \cos \theta = 1030 - (0.967)T$ d/cm and $\rho = [17.56 - (1.45 \times 10^{-3})T] \pm 0.021$ g/cm³ were obtained. A single determination of the liquid density of a plutonium-7.93 atomic percent iron alloy was also made and the value $\rho = [16.88 - (1.36)T] \pm 0.012$ g/cm³ was obtained. (auth)

4278 NAA-SR-4194

Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.

EFFECT OF A THERMAL GRADIENT ON THE HYDROGEN DISTRIBUTION IN A METAL. APPLICATION TO THE SODIUM REACTOR EXPERIMENT. G. G. Libowitz. Dec. 1, 1959. 20p. Contract AT-11-1-GEN-8. OTS.

The distribution of a gas dissolved in a metal under a thermal gradient and constant pressure is considered. Expressions for the concentration gradient and the over-all concentration necessary for compound formation are derived. The derived equations are applied to the problem of the distribution of hydrogen in the zirconium cans of the Sodium Reactor Experiment. It is shown that if the over-all hydrogen concentration exceeds 4×10^{-4} atoms of hydrogen per atom of zirconium, δ -phase zirconium hydride will form at the cooler part of the zirconium cans. (auth)

4279 NP-8146

Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw.

PRECIPITATION OF SPARINGLY SOLUBLE SALTS IN COMBINATION WITH CRYSTALLIZATION IN THE METASTABLE SUPERSATURATION REGION. Report No. 91/IV. T. Adamski and S. Rykowski. June 1959. 8p.

Experiments are described in which very dilute reagents are mixed at a slow rate resulting in metastable supersaturation and precipitation. Barium chromate was used as the model substance, and the salt was precipitated by mixing a solution of BaCl_2 of a suitable concentration with a solution of K_2CrO_4 . Optimum concentrations were found and it was noted that seed crystals form at higher rates of addition. The use of columns allows more intensive crystallization. It was concluded that simple recrystallization does not occur. (J.R.D.)

4280 NP-8155

Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw.

PREPARATION OF SODIUM α -NAPHTHYLPHOSPHATE AND PHOSPHORUS OXYCHLORIDE LABELLED WITH P^{32} . Report No. 104/XIII. K. Russin and A. Szuchnik. Aug. 1959. 10p.

A semi-micro method for preparation of P^{32} labeled disodium α -naphthylphosphate and phosphorus oxychloride from hydrated labeled phosphoric acid and pentachloride is presented. (auth)

4281 NP-8159

Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw.

VISCOSITY OF LIQUID HYDROGEN SULPHIDE. Report

No. 109/OFJ. J. W. Hennel and K. Krynicki. Sept. 1959. 8p.

The viscosity of liquid H_2S under pressure of its saturated vapor at -11.5 to $50^\circ C$ was measured. A closed-type, pressure-resistant Ostwald viscometer was used. (auth)

4282 NP-8162

Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw.

PREPARATION OF SINGLE CRYSTALS OF NICKEL AND Ni-Fe ALLOY. Report No. 112/I-B. A. Modrzejewski. Sept. 1959. 8p.

An apparatus for preparation of single crystals of Ni and Ni-Fe alloy is described. The Bridgeman method is used, and conditions for growing the crystals are given. (auth)

4283 NYO-7405

Columbia Univ., New York.

THE RATES OF ADSORPTION OF POLYMERIC FLOCCULATING AGENTS ON CHEMICALLY PURE SOLIDS. ELECTROPHORETIC MOBILITY IN RELATION TO POTENTIAL DETERMINING IONS AND FLOCCULATION BY POLYMERIC FLOCCULATING AGENTS. Final Report from September 1, 1957 to May 31, 1959. Victor K. LaMer and Robert H. Smellie, Jr. Aug. 31, 1959. 32p. Contract AT(30-1)-1189. OTS.

Progress on investigations of the flocculation mechanism in relation to adsorption, surface potential (or charge) and filtration rate is reported. The rate of adsorption of polymeric flocculants in suspensions which are shaken, is much faster than in solutions which are not agitated, although well mixed. After a given period of time, the total amount of polymer adsorbed increases with the total amount of agitation applied during the time period. The equilibrium amounts of Lytron 886 and Separan 2610 which can be adsorbed per gram of finely divided $CaSO_4 \cdot 2H_2O$ and $Ca_3(PO_4)_2$, respectively, are relatively large, being in the order of 10^{-3} g of polymer per g solid. In the case of the adsorption of Lytron 886 on $CaSO_4 \cdot 2H_2O$ a period of at least 90 hr with continuous shaking is required to obtain final equilibrium when the initial concentrations of Lytron 886 in the range of 0.010 to 0.025% by weight and the solid content is 10% by weight. The equilibrium data follow a Langmuirian adsorption isotherm. It was also found that the adsorption data for shorter times of contact between polymer and solid follow the Langmuirian form. The time required to reach final adsorption equilibrium with finely divided $Ca_3(PO_4)_2$ and Lytron 886 is 20 to 30 minutes. Thus the rate of Lytron 886 on $Ca_3(PO_4)_2$ is 200 to 300 times as fast as the rate for $CaSO_4 \cdot 2H_2O$. The total quantities of Lytron 886 adsorbed on $CaSO_4 \cdot 2H_2O$ and $Ca_3(PO_4)_2$ which would also be dependent on specific surface (yet to be determined) are about the same. Data are presented graphically. (J.R.D.)

4284 WADC-TN-59-115

Wisconsin. Univ., Madison.

BINARY NITROGEN COMPOUNDS OF THE ELEMENTS: A LITERATURE SURVEY. Rosemary G. Ehl, Rodney J. Sime, and John L. Margrave. June 1959. 79p. Project No. 3048. Contract AF33(616)-3023. OTS.

A literature survey has disclosed the existence of more than 195 binary compounds of nitrogen with the other elements of the periodic system. About 80% of the known binary nitrogen compounds are nitrides while the rest are azides. Combinations with at least 75 elements are reported. In this report are presented a comprehensive bibliography and a set of tables designed to make it con-

venient for a researcher to locate preparative, crystallographic, or thermodynamic data. Miscellaneous references are also listed. (auth)

4285 AEC-tr-3679

LIMITS OF APPLICABILITY OF THE FIRST ORDER KINETIC EQUATION FOR ISOTOPIC EXCHANGE. Ya. M. Varshavskii and S. E. Vaisberg. Translated from Los Alamos Scientific Lab. from *Zhur. Fiz. Khim.* **32**, 454-9 (1958). 8p. JCL or LC.

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 12, as abstract No. 10383.

4286 AEC-tr-3919

THE DETONATING FORCE OF LIQUID EXPLOSIVE MIXTURES BASED ON NITRIC ACID. (O Detonatsionnay Sposobnosti Zhidkikh Vzryvchatykh Smesey na Osnove Azotnoy Kisloty). R. Kh. Kurbanalina. Translated from *Zhur. Priklad. Khim.* **32**, 1467-70 (1959). 9p. JCL or LC.

The detonating force of mixtures of nitric acid with nitrobenzene, meta-nitrotoluene, dichlorethane, and glycol were investigated. It was found that all of these mixtures are explosive and detonate at rates of 6000 to 7000 m/sec depending on their individual properties. The values of the critical diameters for most of the investigated mixtures are very small. An assumption based on this fact is that mixtures of nitric acid with minerals can explode due to shock, shaking, or heating. Data from the tests and on detonation rates are included. (J.R.D.)

4287 HW-61492

THE LAW OF OXIDATION OF METALLIC CERIUM. GENERALIZATION TO OTHER METALS. [Jean] Loriers. Translated by C. Groot (Hanford Atomic Products Operation) from *Compt. rend.* **231**, 522-4 (1950). 5p. OTS.

The total process of the oxidation of cubic cerium results from the superposition of the elementary reactions $2 Ce = 3O \rightarrow Ce_2O_3$ and $Ce_2O_3 + O \rightarrow 2 CeO_2$. The rule of equivalent volumes shows that the sesqui-oxide forms a continuous film on the metal. Its growth takes place by diffusion, following a parabolic law. In contrast, the dioxide, with a smaller equivalent volume, allows the cubic Ce_2O_3 to be in direct contact with the oxygen, and hence the CeO_2 grows according to a linear law. From these bases, the process of dry oxidation as a function of time is predicted. This law was verified only for the oxidation of cerium but appears to be applicable each time that the action of a gas on a metal gives rise to a protective film which is transformed into a porous layer at a constant rate. The oxidation of uranium, according to the studies, can be interpreted in this fashion. (auth)

4288

THE ENTHALPY OF WATER IN THE LIQUID STATE. Robert Byrne and George Thodos (Northwestern Univ., Evanston, Ill.). *A.I.Ch.E. Journal* **5**, 551-5 (1959) Dec.

The enthalpy of water in the liquid state was calculated from $32^\circ F$ to temperatures approaching the critical and pressures ranging from saturated conditions to 160,000 psia (approximately 11,000 atm). The results of this study are presented graphically and show that the influence of pressure on enthalpy is significant, particularly in the lower temperature region. At these conditions pressure is found to increase the enthalpy of liquid water by as much as 360 Btu/lb above the corresponding enthalpy of the saturated liquid state. A comprehensive literature search disclosed PVT data for water that permitted the construction of a density correlation. This correlation expressed in reduced coordinates extends from the normal freezing point of water to temperatures of $1,870^\circ F$

($T_R = 2.0$) and pressures ranging up to 10,915 atm ($P_R = 50$). The recent extensive PVT data of Kennedy reported in 1950 supplemented with the earlier data of Amagat and Bridgman allowed the calculation of enthalpies at these elevated temperatures and pressures. For these calculations basic thermodynamic relationships were adapted which utilized this reduced density correlation. This approach made possible the extension of the thermodynamic properties of liquid water above the highest pressure reported by Keenan and Keys. Below this pressure of 6,000 psia good agreement was found to exist between the enthalpy values presented by Keenan and Keyes and those reported. (auth)

4289

ALTERNATING CURRENT POLAROGRAPHY: TENSAM-METRIC INVESTIGATION OF ADSORPTION PROCESSES. UTILITY OF PHASE-ANGLE MEASUREMENTS. H. H. Bauer and P. J. Elving (Univ. of Michigan, Ann Arbor). *Australian J. Chem.* 12, 343-6(1959).

Tensammetric measurements, based on interpretation of the non-faradaic alternating current flow under conditions of alternating current polarography, were used to study the adsorption of various substances on mercury electrodes. Such measurements can be greatly improved by use of an apparatus arrangement which permits measurement of both the alternating current and the phase angle; from the latter, the series resistance and the capacity of the electrical double layer can be calculated. The application to inorganic systems involving retrograde currents and film formation is described. (auth)

4290

NUCLEAR MAGNETIC RESONANCE AND ITS APPLICATIONS IN CHEMISTRY. M. Van Meerssche and J. J. Capart (Laboratoire de chimie-physique, Louvain, Belg.). *Ind. chim. belge* 24, 1189-1206(1959) Oct. (In French)

Applications of NMR in physical chemistry are discussed. The principle of the technique and the apparatus used are described. Resonance in solids and liquids are treated and examples of various applications are given. (T.R.H.)

4291

DETERMINATION OF SODIUM VAPOR PRESSURE AT TEMPERATURES FROM 880 TO 1300°C. P. L. Kirillov and N. S. Grachev. *Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R.* 2, No. 5, 3-7(1959) May. (In Russian)

A method for determining the saturated vapor pressure of sodium at 880 to 1300°C is described. The results are compared with the work of other authors. An equation is proposed for calculating saturated vapor pressure at various temperatures. (C.J.G.)

4292

THERMODYNAMICS OF TANTALUM, NIOBIUM, TITANIUM, ZIRCONIUM, HAFNIUM, AND ALUMINUM CHLORIDE COMPOUNDS WITH ALKALI METAL CHLORIDES. I. S. Morozov and D. Ya. Toptygin (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). *Izvest. Akad. Nauk S.S.S.R., Otdel. Khim. Nauk* No. 11, 1920-27(1959) Nov. (In Russian)

The thermal stability of aluminum, hafnium, niobium, tantalum, titanium, and zirconium chloride compounds with alkali metal chlorides was studied, and the ΔH , ΔS , and ΔF of decomposition reactions were estimated. (R.V.J.)

4293

THE DISSOCIATION ENERGY OF FLUORINE AND THE MAGNETIC DEFLECTION OF ITS MOLECULAR BEAMS.

Thomas A. Milne and Paul W. Gilles (Univ. of Kansas, Lawrence). *J. Am. Chem. Soc.* 81, 6115-20(1959) Dec. 5.

A molecular beam of fluorine atoms and molecules issuing from a furnace passed through an inhomogeneous magnetic field and impinged on a detector of thin tellurium metal. It was shown that the detector responded to atoms alone. Two kinds of measurements of the atomic beam were made. They were absolute intensity measurements at two different temperatures and relative intensity measurements at several different temperatures. Dissociation energies obtained from the two kinds of measurements are in good agreement, and the average of six determinations by the second method is $D_0 = 41.3 \times 0.5$ kcal mole. (auth)

4294

COMPOSITION AND STABILITY OF 5-SULFOSALICYLATE COMPLEXES OF BERYLLIUM AND COPPER. Charles V. Banks and Rajendra S. Singh (Ames Lab., Ames, Iowa). *J. Am. Chem. Soc.* 81, 6159-63(1959) Dec. 5.

Spectrophotometric studies of the beryllium-5-sulfosalicylate system indicate the presence of two complexes: one predominating at pH 5.2 and another predominating at pH 8.0. Job's method of continuous variations showed that at pH 5.2 the ratio of beryllium to 5-sulfosalicylate in the predominant complex is 1:1. Evidence is presented that the phenolic proton of 5-sulfosalicylic acid is displaced upon formation of either the 1:1 or the 1:2 complex. The stability constants of the beryllium-5-sulfosalicylate complexes were calculated spectrophotometrically and by Bjerrum's method. The log k values were found to be $\log k_1 = 11.46$, $\log k_2 = 8.62$ and $\log k_1 = 11.50$, $\log k_2 = 8.84$, respectively. The stability constants of the two known copper-5-sulfosalicylate complexes were calculated by Bjerrum's method and the log k values were found to be $\log k_1 = 9.27$ and $\log k_2 = 6.64$. (auth)

4295

THE BARIUM FLUORIDE-URANIUM TETRAFLUORIDE AND THE STRONTIUM FLUORIDE-THORIUM TETRAFLUORIDE SYSTEM. R. W. M. D'Eye and I. F. Ferguson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). *J. Chem. Soc.*, 3401-4(1959) Nov.

BaF_2-UF_4 and SrF_2-ThF_4 systems were examined by x-ray diffraction and density measurements. The tetrafluoride dissolves in difluoride to the extent of about 25 M %, the unit-cell constant decreasing in the former and increasing in the latter system. Barium and strontium fluorides dissolve in barium uranium hexafluoride and strontium thorium hexafluoride respectively to the extent of about 20 M % with the creation of anion vacancies. At 60 M % of uranium tetrafluoride a previously unidentified compound is formed. Below this exists a two-phase region down to UF_4 . An analogous compound is not found in the SrF_2-ThF_4 system, so that, between 50 and 100 M % of thorium tetrafluoride, only strontium thorium hexafluoride and thorium tetrafluoride are found. (auth)

4296

THE INTERACTION OF RARE EARTH IONS WITH DIETHYLENETRIAMINEPENTAACETIC ACID. R. Harder and S. Chaberek (Dow Chemical Co., Framingham, Mass.). *J. Inorg. & Nuclear Chem.* 11, 197-209(1959) Oct.

The interactions of rare earth ions with diethylenetriaminepentaacetic acid (DTPA) were investigated by potentiometric procedures. Metal chelate formation constants were calculated and compared with those defining similar interactions with ethylenediaminetetraacetic acid and N -hydroxyethylethylenediaminetriacetic acid. (auth)

4297

POLAROGRAPHIC REDUCTION OF URANIUM(VI) UNDER COMPLEXING AND NONCOMPLEXING CONDITIONS. NATURE OF THE URANIUM(V) SULPHATE COMPLEX.

Philip J. Elving and Alan F. Krivis (Univ. of Michigan, Ann Arbor). *J. Inorg. & Nuclear Chem.* **11**, 234-41 (1959) Oct.

The polarographic reduction of U(VI) to U(V) in acid solution is sensitive to both type and concentration of anion present. Consequently, the reduction was studied using perchlorate as a non-complexing anion and sulfate as a complexing anion. In HClO_4 solution, increasing the perchlorate concentration shifts $E_{1/2}$ to more positive potentials, which seem to correspond to junction potential effects. Increasing either HClO_4 or perchlorate concentrations increases the limiting current slightly, which can be attributed to a higher rate of disproportionation of U(V). Other factors, as the viscosity of the solution, tend to counteract the effect of the disproportionation. In sulfate media, UO_2^{2+} is not strongly complexed, the association constant for the U(V)-sulfate complex being ca. 0.13, if UO_2SO_4 is the most stable uranyl sulfate complex present. The effect of acid on the stability of the latter complex confirmed its existence as an uncharged species. Limiting currents are pseudo diffusion-controlled, e.g., increasing the solution viscosity by increasing the electrolyte content decreases the current. This is due to the maximum disproportionation rate of U(V) having been reached at even the lowest sulfuric acid level investigated. Increasing the anion concentration consequently slows down diffusion. (auth)

4298

ISOTOPE EFFECT IN THE ELECTROMIGRATION OF LITHIUM IONS IN AGAR-AGAR GEL. H. J. Arnikar (Collège de France, Paris). *J. Inorg. & Nuclear Chem.* **11**, 248-51 (1959) Oct.

The relative difference of ionic mobility of the lithium isotopes Li^6 and Li^7 after zone electromigration in agar-agar gel was found to be 0.0036. The isotope effect was calculated to be 0.023. The values of the ratio Li^7/Li^6 observed at the cathodic and anodic ends of the zone were 8.8 and 15.2 respectively. (C.J.G.)

4299

MAGNESIUM(II) IODIDE 6- AND 2-AMMONIATES. G. W. Watt and D. R. Foerster (Univ. of Texas, Austin). *J. Inorg. & Nuclear Chem.* **11**, 253-5 (1959) Oct.

The reactions between Mg and liquid ammonia solutions of iodine were examined in an effort to produce anhydrous MgI_2 . Thermal deammoniation of the reaction products failed to yield the pure iodide; however, the 6- and 2-ammoniates were isolated and characterized. X-ray-diffraction data are tabulated. (D.E.B.)

4300

THORIUM(IV) AMIDOIODIDES. G. W. Watt and S. C. Malhotra (Univ. of Texas, Austin). *J. Inorg. & Nuclear Chem.* **11**, 255-6 (1959) Oct.

The reaction between thorium(III) iodide and liquid ammonia was previously interpreted as leading to the formation of hydrogen and the 4-ammoniate of thorium(IV) amidotriiodide. Upon reinvestigation the reaction products were found to consist of equimolar quantities of the ammonia-soluble 3-ammoniate of the diamidodiodide and potassium and sodium iodides. (C.J.G.)

4301

TRITIUM-RADIOISOTOPE OF HYDROGEN. Wiktor Smulek (Instytut Badán Jądrowych PAN, Warsaw). *Nukleonika* **4**, 371-80 (1959). (In Polish)

The properties, use, and production of tritium are discussed. (C.J.G.)

4302

THE EFFECT OF PRESSURE ON THE ABSORPTION EDGE IN HEAVY-METAL HALIDES. J. C. Zahner and H. G. Drickamer (Univ. of Illinois, Urbana). *Phys. and Chem. Solids* **11**, Nos. 1-2, 92-6 (1959) Sept.

The effect of pressure was measured on the absorption edge of ten heavy-metal halides. In general, a large decrease in the gap is obtained with increasing pressure. The differences between the data on thallous halides and previous data on AgCl and AgBr are explained tentatively in terms of differences in band structure postulated by Seitz and Martienssen. Compounds which crystallize in the same lattice show closely similar shifts with pressure (or density) regardless of the halide involved. HgI_2 returns to the high-temperature form above 13,000 atm at room temperature, as has been previously noted by Bridgman. (auth)

4303

THE EFFECT OF PRESSURE ON THE ABSORPTION EDGE OF CERTAIN MOLECULAR COMPOUNDS. H. L. Suchan and H. G. Drickamer (Univ. of Illinois, Urbana). *Phys. and Chem. Solids* **11**, Nos. 1-2, 111-14 (1959) Sept.

The effect of pressure was measured on the optical absorption edges of certain molecular crystals, including Hg_2Cl_2 , Hg_2Br_2 , Hg_2I_2 , Cl_4 , SnI_4 , CBr_4 , SnBr_4 , and Cl_3H . In general, the gap decreases with pressure at a rate which tends to accelerate with increasing pressure. The rate of shift of the edge depends strongly on the halogen involved, in contrast to ionic crystals where the shift of the edge depends largely on the structure and the cation. An extrapolation of the data indicates that by 300,000 atm most molecular iodides would have zero optical gap. (auth)

4304

THE EFFECT OF PRESSURE ON ZINC BLENDE AND WURTZITE STRUCTURES. A. L. Edwards, T. E. Slykhouse, and H. G. Drickamer (Univ. of Illinois, Urbana). *Phys. and Chem. Solids* **11**, Nos. 1-2, 140-8 (1959) Sept.

The effect of pressure was measured on the absorption edges of GaP , GaAs , GaSb , ZnS , ZnSe , ZnTe , ZnO , and CdS . A tentative interpretation can be given consistent with previous work on silicon and germanium. Regularities in the shifts in horizontal and diagonal sequences are discussed. An absorption peak which appears (irreversibly) on the low-energy side of the edge of the higher-molecular-weight compounds, and grows with pressure, indicates either the formation of a disordered phase or some chemical decomposition. For GaAs and GaSb both events may be present, but for ZnTe the former course seems definitely the more probable. (auth)

4305

A RADIOCHEMICAL STUDY OF SOME KINETIC AND THERMODYNAMIC PROPERTIES OF COMPLEX IONS OF THE RARE EARTHS. R. H. Betts, Olive F. Dahlinger, and Donna M. Munro (Atomic Energy of Canada Ltd., Chalk River, Ont.). *Radioisotopes in Sci. Research* **2**, 20p. (1958).

Radioactive nuclides of La, Nd, Dy, and Yb were used to investigate the kinetics of the isotopic exchange reactions between the forms $\text{R}_{\text{AO}}^{3+}$ and RX^- in aqueous solution. X represents the organic chelating agent ethylene diamine tetra-acetic acid. The principal path leading to exchange is the acid catalyzed dissociation of RX^- ; the rate of exchange is given by the expression: $k(\text{H}^+)^{1.0}(\text{RX}^-)^{1.0}(\text{R}_{\text{AO}}^{3+})^{0.0}$.

For comparable conditions, the rate constants are in the ratio $k_{La} : k_{Nd} : k_{Dy} : k_{Yb} :: 7700 : 1200 : 19 : 1$. At 25°C, $k_{La} = 4.2 \times 10^5$ litre mole⁻¹ min⁻¹. Two cross exchange reactions between different rare earths were also examined by radiochemical methods. These include $LaX^- + Nd^{3+}_{aq} \rightleftharpoons NdX^- + La^{3+}_{aq}$, as well as the pair Nd-Dy. For the La-Nd system, the kinetics of the opposing reactions involved in the equilibrium were investigated separately. It is found that the kinetic behavior of these non-isotopic systems can be related fairly simply to the kinetics of the corresponding isotopic exchange reactions. Measurements of the position of equilibrium were also made, and these are discussed in terms of the difference in stability of the complex ions involved. Evidence is presented which suggests that the main factor responsible for the increased stability of NdX^- relative to LaX^- is the more negative partial molal entropy of Nd^{3+}_{aq} as compared to that of La^{3+}_{aq} . (auth)

4305

AN X-RAY STRUCTURAL PHASE ANALYSIS OF THE Zr-H AND Ti-H SYSTEMS. V. V. Sof'ina, Z. M. Azarkh, and N. N. Orlova. *Soviet Phys.-Cryst.* **3**, 544-50(1959) Dec.

The crystal structures in the Zr-H and Ti-H systems were studied by x-ray methods. It is found that the changes in structure on absorption of hydrogen are analogous in each system. With high hydrogen content a homogeneous range of a cubic β -phase is observed, which becomes tetragonally distorted near the limiting composition ZrH_2 and TiH_2 . The limits of this range do not correspond to a simple stoichiometric ratio between the components. (auth)

4307

INFRARED ABSORPTION OF SILICON OF HIGH RESISTIVITY CONTAINING RADIATION DEFECTS. V. S. Vavilov, A. F. Plotnikov, and G. V. Zakhvatkin (Lebedev Inst. of Physics, Moscow). *Soviet Phys.-Solid State* **1**, 894-7(1959) Dec.

The absorption coefficients of p-type silicon were obtained by fast neutron irradiation at 1 Mev (temperature <100°C) in the region 1 to 10 μ . The integral flux of neutrons was $\sim 5 \times 10^{17}$ cm⁻². Prior to irradiation the specimens had hole conductivity and $\rho = 65$ ohms at room temperature. After irradiation, the resistivity increased to 2×10^5 ohms per cm and the concentration of holes at 300°K was 2.5×10^{11} cm⁻³. The absorption coefficient of the silicon in the region 2.2 to 7 μ at room temperature did not exceed 0.1 cm⁻¹. The absorption band, with a maximum near 1.8 μ at room temperature, became narrower as the temperature was lowered and shifted to 1.7 μ at 20°K. (C.J.G.)

4308

PREPARATION AND PHYSICO-CHEMICAL PROPERTIES OF PLUTONYL CHLORIDES. I. F. Alenchikova, L. L. Zaitseva, L. V. Lipis, and V. V. Pomin. *Zhur. Neorg. Khim.* **4**, 961-2(1959) May. (In Russian)

Plutonyl chloride ($PuO_2Cl_2 \cdot 6H_2O$) was synthesized from plutonyl chloride solution at room temperature. Electron and infrared spectra showed the presence of PuO_2^{2+} and the absence of any traces of Pu^{4+} . Long storage produces a radical change in the electron and infrared absorption spectrum caused by the reduction of Pu by the action of α radiation. (R.V.J.)

4309

COMPOSITION OF PRASEODYMIUM OXIDES. M. A. Ambrozhiĭ and A. M. Gol'tsev (Chernyshevskĭ Saratov State Univ.). *Zhur. Neorg. Khim.* **4**, 969-71(1959) May. (In Russian)

A chemical method is offered for determining the pres-

ence of tetravalent praseodymium and the quantitative analysis of PrO_2 in praseodymium oxides. (R.V.J.)

4310

PREPARATION AND PROPERTIES OF NIOBIUM IODIDES. D. M. Chizhikov and A. M. Grin'ko (Baikov Inst. of Metallurgy, Academy of Sciences, USSR). *Zhur. Neorg. Khim.* **4**, 979-81(1959) May. (In Russian)

The preparation of penta-, tetra-, and tri-niobium iodides by passing iodine vapor over metallic niobium at various temperatures is described, and the properties of the compounds were determined. (R.V.J.)

4311

MELT DIAGRAMS FOR LiF-NaF-CaF SYSTEMS. G. A. Bukhalova, K. Sulaimankulov, and A. K. Bostandzhiyan (Rostov-on-Don Construction Inst.). *Zhur. Neorg. Khim.* **4**, 1138-40(1959) May. (In Russian)

The surface crystallization and melt diagrams of LiF-NaF-CaF systems were plotted and analyzed. The combined component crystallization lines converge at the eutectic point of 35.5% Na_2F_2 , 46.5% Li_2F_2 , and 20% CaF_2 at the melting point 607°C. (R.V.J.)

4312

THE TERNARY SYSTEM OF Li, Mg, Ba FLUORIDES. G. A. Bukhalova and V. T. Berezhnaya (Rostov-on-Don Construction Inst.). *Zhur. Neorg. Khim.* **4**, 1141-5(1959) May. (In Russian)

Constitution diagrams for LiF-MgF-BaF systems are plotted and 15 internal cross sections are analyzed in order to determine the crystallization fields of 2 $MgF_2 \cdot BaF_2$, Li_2F_2 , BaF_2 and continuous solutions of Li_2F_2 and MgF_2 which, with the admixture of BaF_2 , disintegrate into separate components. (R.V.J.)

4313

THERMODYNAMIC PROPERTIES OF MELTED SALTS IN $PbBr_2$ -KBr SYSTEM. M. F. Lantratov and T. N. Shevlyakova. *Zhur. Neorg. Khim.* **4**, 1153-8(1959) May. (In Russian)

A method is offered for preparing reversible bromine electrodes. Electromotive forces of chemical chains (graphite) $Pb [PbBr_2(N_1) + KBr(N_2)] Br$ (graphite), with $N_1 = 1.0$ to 0.2 were measured in the temperature range from 380 to 500°C. The electromotive force changes linearly with temperature. Partial thermodynamic data were calculated for both components at 589 and 539°C (molar isobar-isothermal potentials, excess potential, and mixture molar enthalpy). A considerable heat emanation was observed during the formation of $PbBr_2$ -KBr solutions. The maximum magnitude of mixing enthalpy is equal to 7460 kg/g mole. (R.V.J.)

4314

CHEMICAL STATE OF Se^{72} DECAY PRODUCTS. A. Khal'pern (Inst. of Nuclear Research, Academy of Sciences, Poland). *Zhur. Neorg. Khim.* **4**, 1205-8(1959) May. (In Russian)

The chemical state of As^{72} from K capture by Se^{72} was investigated. At a temperature of 20°C the As in 44.3% As^{3+} and 55.7% As^{5+} , while at -196°C it is 34.3% As^{3+} and 67.7% As^{5+} . (R.V.J.)

Analytical Procedures

4315 AERE-AM-32

United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Chatham Outstation, Kent, England.

THE DETERMINATION OF TITANIUM IN BERYLLIUM

METAL. J. Walkden and K. E. Heathfield. Sept. 1959. 6p. BIS.

Cupferron is added to a solution of the sample in excess sulfuric acid and the cupferrides are extracted with chloroform. The extract is evaporated to dryness, ignited, and the ash fused with potassium bisulfate. Titanium is determined absorptiometrically in a sulfuric acid solution of the melt after formation of the thymol complex. The method is suitable for titanium contents of 10 ppm to 100 ppm with an accuracy of $\pm 5\%$. (auth)

4316 BM-RI-5538

Bureau of Mines.

FLUORESCENT X-RAY SPECTROGRAPHIC ANALYSIS: STUDIES OF LOW-ENERGY K, L, AND M SPECTRAL LINES. William J. Campbell. 1959. 21p.

These investigations were undertaken as part of a program to determine the optimum x-ray spectral lines to use for analyzing the wide variety of samples received by the x-ray Laboratory. Theoretical calculations and experimental data derived from these investigations show that longer wavelength spectral lines, $> 2\text{\AA}$, are very useful for many analytical problems. Because of the low fluorescence yield of the elements of atomic numbers 13 to 22 and the small depth of penetration of their x-ray spectral lines, these elements were originally considered to be insensitive; however, these studies show that the wide dispersion of their spectral lines, coupled with their weak beta lines, permits the use of wide collimation, thus increasing the line intensity. More importantly, the background due to scattered primary radiation is very low in the long-wavelength region. The L-series lines are preferable to the shorter wavelength K lines for elements of atomic numbers 42 to 60 when certain types of samples are analyzed. With infinitely thick samples the K lines are more intense (because of the greater depth of sample analyzed), but the line-to-background ratio is higher for the L lines from the same element. The L lines are both more intense and have a higher line-to-background ratio when thin samples (for example ion-exchange membranes) are analyzed. M-series lines show little promise for application in x-ray spectrochemical analysis. However, the M lines can interfere with the determination of longer wavelength K and L lines so that future x-ray spectrographic tables should include the M series. (auth)

4317 HW-25859

Hanford Works, Richland, Wash.

IMPROVED SPECTROGRAPHIC ANALYSIS OF URANIUM AND PLUTONIUM BY THE CARRIER CONCENTRATION METHOD. J. L. Daniel. Oct. 7, 1952. Dec. 1, Oct. 7, 1959. 17p. Contract W-31-109-Eng-52. OTS.

From film studies of the emission characteristics of impurities in plutonium and uranium it was found that improved accuracy and precision could be attained by increasing the carrier concentration and using a fixed arcing time for all samples. (C.J.G.)

4318 IGR-196(O/CA)

United Kingdom Atomic Energy Authority. Industrial Group. Capenhurst Works, Capenhurst, Ches., England. ANALYTICAL METHOD FOR THE SPECTROGRAPHIC DETERMINATION OF TRACE IMPURITIES IN MERCURY. July 7, 1959. 18p. BIS.

The impurities are oxidized by use of high-temperature compressed air and separated from the mercury by a fine spray of dilute nitric acid. The solution is evaporated to dryness and examined spectrographically by means of the iron flux technique. The densities of the spectral lines due to the trace impurities are visually compared with those of

iron added as an internal standard and the concentration values obtained from a table. (J.R.D.)

4319 IGR-197(O/CA)

United Kingdom Atomic Energy Authority. Industrial Group. Capenhurst Works, Capenhurst, Ches., England. ANALYTICAL METHOD FOR THE DETERMINATION OF IRON IN MERCURY (ABSORPTIOMETRIC-THIOCYANATE). July 30, 1959. 9p. BIS.

The impurities present in the mercury are oxidized with compressed air at an elevated temperature and obtained as an acid solution by passing the mercury in the form of a very fine spray through a dilute solution of nitric acid. The iron in the acid solution of the impurities is determined absorptiometrically as the ammonium thiocyanate complex. The method is applicable to the determination of iron in mercury containing from 5 to 150 μg of iron per 100 g of mercury. Concentrations outside this range can be determined by suitable adjustment of the sample aliquot. (auth)

4320 PGR-18(S)

United Kingdom Atomic Energy Authority. Production Group. Chemical Services Dept., Springfields, Lancs, England.

ANALYTICAL METHOD FOR THE ABSORPTIOMETRIC DETERMINATION OF CHROMIUM IN ZIRCALOY 2. Aug. 27, 1959. 7p. BIS.

Chromium is oxidized in a sulfuric acid solution to the hexavalent state using potassium permanganate. Excess permanganate is removed by the addition of ethylenediaminetetraacetic acid and the chromium content is determined from the absorbancy of its diphenylcarbazide complex. The method is suitable for chromium contents in the range 5 to 60 μg in the aliquot of the sample taken. The aliquot should contain not more than 0.04 g zirconium. (auth)

4321 PGR-21(S)

United Kingdom Atomic Energy Authority. Production Group. Chemical Services Dept., Springfields, Lancs, England.

ANALYTICAL METHOD FOR THE ABSORPTIOMETRIC DETERMINATION OF COBALT IN ZIRCONIUM METAL AND ZIRCALOY. Aug. 27, 1959. 8p. BIS.

Cobalt is determined absorptiometrically in the metal as the nitroso R-salt complex after complexing the zirconium with citrate and destruction of other nitroso R-salt complexes by boiling with nitric acid. Cobalt is extracted into chloroform from a hydrochloric acid solution of Zircaloy, as the potassium ethyl xanthate complex. The complex is destroyed by wet oxidation and the cobalt determined in the residue as a nitroso R-salt complex. The method is suitable for the determination of cobalt contents in the range 5 to 100 ppm. (auth)

4322 PGR-22(S)

United Kingdom Atomic Energy Authority. Production Group. Chemical Services Dept., Springfields, Lancs, England.

ANALYTICAL METHOD FOR THE ABSORPTIOMETRIC DETERMINATION OF NICKEL IN ZIRCONIUM METAL. Aug. 18, 1959. 7p. BIS.

Zirconium metal is dissolved in a mixture of hydrochloric acid and ammonium fluoride. The pH of the solution is suitably adjusted and the nickel extracted as a dimethylglyoxime complex in chloroform. The nickel is re-extracted using an acid solution, and is measured absorptiometrically as its oxidized dimethylglyoxime complex. The method is suitable for samples having a nickel content in the range 5 to 60 ppm. (auth)

4323 PGR-28(S)

United Kingdom Atomic Energy Authority. Production Group. Chemical Services Dept., Springfields, Lances, England.

ANALYTICAL METHOD FOR THE ABSORPTIOMETRIC DETERMINATION OF CHROMIUM IN ZIRCONIUM METAL AND ZIRCONIUM TETRACHLORIDE. Aug. 27, 1959. 7p. BIS.

The zirconium metal and zirconium tetrachloride are dissolved in sulfuric acid. Chloride ions are removed and the chromium oxidized with ammonium persulfate in the presence of silver nitrate. The chromium is complexed with diphenylcarbazide and the absorbancy measured using a Spekker absorptiometer. The method is suitable for up to 80 μ g of chromium in the aliquot of sample taken. (auth)

4324 TID-7015(Sect.9)

Oak Ridge National Lab., Tenn.

ORNL MASTER ANALYTICAL MANUAL. SECTION 9. PROCESS METHODS. TISE issuance date Sept. 1958. 830p. OTS.

Procedures are given for ionic, radiochemical, spectrographic, nuclear, general process, Thorex Process, isolation process, Purex Process, and radioisotope production process methods of analysis. (W.L.H.)

4325 TID-7015(Suppl. 1)

Oak Ridge National Lab., Tenn.

MASTER ANALYTICAL MANUAL. TISE issuance date Nov. 1959. 525p. OTS.

Procedures are given for ionic, radiochemical, spectrographic, nuclear, general process, Thorex Process, isolation process, Purex Process, and radioisotope production process methods of analysis. (W.L.H.)

4326

SPECTROGRAPHIC DETERMINATION OF SILICON IN ALLOYS OF URANIUM AND SILICON. Guy Baudin and Jacques Ernoult (Centre d'Études Nucleaires, Grenoble, France). *Compt. rend.* **249**, 2321-23(1959) Nov. 30. (In French)

A satisfactory sample was obtained by diluting silicide prepared from roasted $\text{SiO}_2\text{-U}_3\text{O}_8$ with a graphite- Mn_3O_4 mixture. A Jarrell-Ash spectrograph with 2.5 A/mm dispersion was used with the following excitation: C = 0.009 μ F and L = 80 μ H. The lines used were: Mn = 2527.4 A and Si = 252.1 A. The method permits determination of 0.5 to 25% Si in silicides. The quadratic error for 20 determinations was 6.3%. (T.R.H.)

4327

DETERMINATION OF SMALL AMOUNTS OF URANIUM IN MINERALS BY THE PHOSPHATE-VANADATE PROCESS. Cassio Mendonça Pinto, Edith Moysés, and Edson Ribeiro Teixeira (Universidade de Minas Gerais, Brazil). *Fóton* **1**, 13-20(1959) May. (In Portuguese)

The phosphate-vanadate determination of uranium is based on the precipitation of uranium(IV) with sodium phosphate in acid solution and subsequent titration of uranium(IV) with vanadate ion in strong sulfuric acid solution. In the phosphate precipitation all elements are removed except zirconium, titanium, and thorium, and they do not interfere with the titration. In the process the ore is leached in hydrochloric acid, and sodium phosphate is added to the solution. The uranium is precipitated along with Zr, Ti, and Th, but all other elements remain in solution. The precipitate is then dissolved with sulfuric acid and titrated with ammonium metavanadate. The indicator used is N-phenylanthranilic acid. The results obtained show that the method is simple and precise for the

determination of small amounts of uranium in minerals and ores. (J.S.R.)

4328

SEARCH FOR RADIOACTIVE ELEMENTS IN BRAZILIAN MINERALS. Dulce de Andrade Silveira and Harry Gomes (Universidade de Minas Gerais, Brazil). *Fóton* **1**, 21-3 (1959) May. (In Portuguese)

An attempt was made to verify the hypothesis of Coppens (*Compt. rend.* **243**, 582(1956)) on the probable existence of natural alpha emitters associated with ferrous minerals. The tests were made on Brazilian ferri-ferrous minerals. The results obtained, using nuclear emulsions, led to the conclusion of the impossibility of the existence of the radioactive groups found by Coppens and to the probable existence of a systematic error which might be responsible for the previous results. No trace was found of the alpha emitters with very long path previously reported. (J.S.R.)

4329

COLORIMETRIC DETERMINATION OF RHENIUM IN PRESENCE OF MOLYBDENUM. V. M. Tarayan and L. G. Mushegyan (Inst. of Geology, Academy of Sciences, Armenian SSR). *Izvest. Akad. Nauk Armyan. S.S.R. Ser. Khim. Nauk* **11**, 397-408(1958). (In Russian)

Descriptions are given of a colorimetric method for determining rhenium in aqueous solutions with and without preliminary separation of molybdenum. Also, a simplified method is suggested for molybdenum separation from rhenium. (R.V.J.)

4330

DETERMINATION OF CHLORINE IN MUSCLE TISSUES BY NEUTRON ACTIVATION ANALYSIS. Jonas Bergström (St. Erik's Hospital, Stockholm). *Nature* **184**, Suppl. No. 19, 1504-05(1959) Nov. 7.

Procedures are described for the determination of chlorine in muscle tissue by activation analysis. (C.H.)

4331

DIFFUSION COEFFICIENT MEASUREMENT BY THE RADIOACTIVATION ANALYSIS AND ISOTOPIC DILUTION METHODS. G. Ya. Ryskin (Leningrad Physicotechnical Inst., Academy of Sciences, USSR). *Soviet Phys.-Solid State* **1**, 870-72(1959) Dec.

The possibility of measuring very small diffusion coefficients by determining the total amount of the diffused substance by means of radioactivation analysis and isotopic dilution methods is discussed. The characteristics of these methods and their possible application in experimental research are discussed. (auth)

4332

IMPROVEMENTS IN OR RELATING TO METHODS OF AND MEANS FOR RADIOACTIVATION ANALYSIS. John Laban Putman and William Henry Taylor (to United Kingdom Atomic Energy Authority). British Patent 824,789. Dec. 2, 1959.

A neutron activation analysis method is offered for determining traces of one material in another. Two scintillation counters with NaI(Tl) crystals are used, one being exposed to an irradiated sample containing the unknown, the other being exposed to a sample identical except that it does not contain the unknown element. The photomultipliers are alternately connected to an amplifier by a multivibrator switch which generates a 0.5-sec square wave pulse. The amplifier output goes to a single-channel pulse analyzer whose discriminator bias is varied by a potentiometer ganged to the driving mechanism of a recorder. The kicksorter output is switched synchronously with the other switch to a double ratemeter. The

ratemeter output is proportional to the difference of the input pulses. Thus photoelectric peaks characteristic of the unknown element are isolated. (T.R.H.)

Radiation Chemistry

4333 IDO-16033

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

IRRADIATION OF RADIUM IN MTR. George H. Hanson. Nov. 10, 1952. Decl. Nov. 23, 1959. 14p. OTS.

The production of Ac^{227} , Th^{227} , Th^{228} , and He from irradiation of Ra in the Materials Testing Reactor was quantitatively calculated. (C.J.G.)

4334 LA-1376

Los Alamos Scientific Lab., N. Mex.

EXPLORATORY STUDIES OF HYDRAZINE FORMATION BY RADIOACTIVE IONIZATION. Harold M. Busey. June 1951. Decl. Nov. 23, 1959. 25p. Contract W-7405-eng-36. OTS.

The production yields of hydrazine by various ionization methods are compared. The maximum value of M/N (number of molecules reacting per ion pairs) for electric discharge was 0.25 and for β particles on liquid ammonia, $M/N = 0.31$. A 1-Mev reactor could produce 1.6 kg of hydrazine per hour if $M/N = 0.04$ as determined by alpha particles on liquid ammonia. About 300 ev of energy were needed to form a hydrazine molecule. (C.J.G.)

4335 NYO-2870

Mellon Inst. Radiation Research Lab., Pittsburgh.

PREPARATIVE RADIATION CHEMISTRY: REACTION OF NITRIC OXIDE WITH SOME ORGANIC LIQUIDS INDUCED BY HIGH ENERGY ELECTRONS. Arnim Henglein. Dec. 4, 1959. 17p. Contract AT(30-1)-2310. (RRL-32). OTS.

Radiation induced reactions of carbontetrachloride, chloroform, trichlorobromomethane, trichloronitromethane, 1,1,1-trichloroethane, and cyclohexane solutions of nitric oxide have been studied. Intense beams of 3 Mev electrons have been used and the reactions have been carried out up to conversions of about 10%. Some of the reactions studied are of preparative interest since they allow the laboratory synthesis of new compounds or easier synthesis of compounds already known. Trichloronitrosomethane is formed in carbontetrachloride ($G = 4.5$), trichlorobromomethane ($G = 5.2$), and trichloronitromethane ($G \sim 6$). Dichloronitrosomethane which has not been synthesized to date is formed in chloroform ($G \sim 0.5$). Similarly, 1,1-dichloro-1-nitrosoethane has been observed in the irradiation of 1,1,1-trichloroethane. The primary reaction product in cyclohexane is assumed to be cyclohexanone oxime which is immediately reduced by free organic radicals or hydrogen atoms to give the amine and hydroxylamine. The observed reactions are explained by scavenging of free radicals from the radiolysis of the liquid by nitric oxide and, in some cases, subsequent changes of the nitroso compounds formed. (auth)

4336 NYO-2871

Mellon Inst. Radiation Research Labs., Pittsburgh.

PREPARATIVE RADIATION CHEMISTRY: THE REACTIONS OF HYDROCARBONS WITH PHOSPHORUS TRICHLORIDE AND OTHER INORGANIC CHLORIDES UNDER THE INFLUENCE OF HIGH ENERGY ELECTRONS. Arnim Henglein. Dec. 4, 1959. 18p. Contract AT(30-1)-2310. (RRL-33). OTS.

Hydrogen chloride is eliminated and organic phosphorus dichlorides, dichlorophosphine oxides, arsenic dichlorides,

and silicon trichlorides are formed in the irradiation of mixtures of various hydrocarbons with phosphorus trichloride, phosphorus oxychloride, arsenic trichloride, and silicon tetrachloride, respectively. The yields of these products have been found to amount often to 40 to 50% of the reacted material at conversions of 20 to 30%. Although these processes do not occur as chain reactions they often are useful for laboratory preparation of those compounds. Some by-products of these reactions have been determined. Hot H and Cl atoms are postulated as intermediates of the reactions to explain the unexpectedly high relative yields of the above mentioned reaction products. (auth)

4337

DEVELOPMENT OF THE RADIATION CHEMISTRY OF AQUEOUS SOLUTIONS. Edwin J. Hart (Argonne National Lab., Lemont, Ill.). *J. Chem. Educ.* **36**, No. 6, 266-72 (1959) June.

An historical review is presented on the development of the radiation chemistry of aqueous solutions relative to three periods: 1900 to 1925, 1925 to 1940, and 1940 to the present. The development of dosimetry and methods of analyzing chemical reactions are discussed. (C.J.G.)

4338

DEVELOPMENT OF CURRENT CONCEPTS OF ELEMENTARY PROCESSES IN RADIATION CHEMISTRY. Milton Burton (Univ. of Notre Dame, Ind.). *J. Chem. Educ.* **36**, No. 6, 273-8 (1959) June.

The development of theories governing elementary processes in radiation chemistry such as the iron-cluster and EHT theories and theories on the mechanism of a neutralization process are discussed. The study of excited molecules in liquids and related systems is discussed. Theories on free-radical diffusion in liquids and electron trapping are presented. (C.J.G.)

4339

THEORETICAL FOUNDATIONS OF RADIATION CHEMISTRY. Aron Kuppermann (Univ. of Illinois, Urbana). *J. Chem. Educ.* **36**, No. 6, 279-85 (1959) June.

Theoretical foundations of processes in radiation chemistry are reviewed. The physical stage, consisting of the dissipation of radiant energy in the system, is reviewed relative to loss of energy by charged particles and high-energy photons and the effect of energy transfer on the medium. The physicochemical stage, consisting of the processes which lead to the establishment of thermal equilibrium in the system, is discussed. The chemical stage, consisting of diffusion and chemical reaction of the reactive species leading to the establishment of chemical equilibrium, is reviewed relative to ionic and free radical reactions and diffusion kinetics of these reactions. (C.J.G.)

4340

RADIOCHEMICAL POLYMERIZATION PROCEEDING BY AN IONIC MECHANISM. Adolphe Chapiro and Vivian Stannett (C.N.R.S., [Paris]). *J. chim. phys.* **56**, 830-33 (1959) Oct. (In French)

Ionic polymerization of styrene initiated by ionizing radiation was studied as a function of temperature in chloride solvents. By preventing radical polymerization using air and benzoquinone, the activation energy for cationic polymerization was determined (-2.5 kcal/mole). Some results are given from studies of ionic copolymerization of styrene with methyl methacrylate. (tr-auth)

4341

ACCELERATION MECHANISM OBSERVED DURING RADIOCHEMICAL GRAFTING OF POLYMERS. J. Dobo

and A. Somogyi (Institut De Recherches De Chimie Organique et Matieres Plastiques, Budapest). *J. chim. phys.* **56**, 863-6(1959) Oct. (In French)

The rate of radioinduced grafting in polyethylene-methyl methacrylate and polyethylene-styrene systems was studied by sealing the sample with monomer in a glass tube and irradiating, weighing dry before and after. It is concluded that the radioinduced graft reaction is a fast reaction because of free radicals induced on side chains of the polymer molecules. This is different from the "gel effect." The assumption that the graft reaction efficiency can be described by comparing f values of base polymer and monomer is not generally valid. Other factors must be taken into account, such as the gel effect, radiochemical, sensitivity of the grafted side chains, and the radiochemical protection and swelling of the polymer by the monomer. From the dose utilization point of view, grafting in the presence of the monomer is more advantageous than pre-irradiation of the polymer and gives a more widely branched product. One can use the study of auto-acceleration in grafting to estimate the relation between G_R of the initial polymer and G_R of the graft polymer. (T.R.H.)

4342

RADIOCHEMICAL DEGRADATION OF HIGH POLYMERS IN SOLUTION. III. MECHANISMS OF RADIOLYSIS OF POLYSTYRENE IN DILUTE SOLUTION. Remarks on the Oxidizing Radiolysis of CHCl_3 and CCl_4 . Jean Durup (Laboratoire de Chimie Physique de la Faculte des Sciences, Paris). *J. chim. phys.* **56**, 873-87(1959) Oct. (In French)

Mechanisms previously proposed for the radiolysis of polystyrene in chloroform solution are made more exact by complementary results. Analogous studies were performed on gamma-ray degradation of polystyrene in CCl_4 , then on a solution in CHCl_3 under nitric oxide atmosphere. Starting with polystyrene peroxide by irradiation of aerated solutions in chlorinated methanes, the polymerization of different monomers was initiated with graft copolymer formation. The radiochemical oxidation of CHCl_3 and CCl_4 was manometrically studied. The inhibitory effect of alcohols on chain oxidation of CHCl_3 is discussed. The study of oxidizing radiolysis of CCl_4 gave a more exact determination of the primary radiochemical yields of this compound. (tr-auth)

4343

ON THE REDUCTION OF FERRIC IONS CAUSED BY OPERATION OF γ -RADIATION UPON AQUEOUS SOLUTIONS CONTAINING CERTAIN ORGANIC SUBSTANCES. A. I. Chernova (Karpov Inst. of Physical Chemistry, Moscow) and S. Ya. Mints (Inst. of Nuclear Studies, Warsaw). *Nukleonika* **4**, 365-70(1959). (In Polish)

Radiolytic reduction of ferric ions by gamma radiation in the presence of oxalic acid, glycerin, and glucose was studied. The results of the reduction are presented as the concentration of ferrous ions as a function of dose. The addition of oxalic acid (1 M) and glucose or glycerin were found to cause a strong rise of the initial reduction yield of 0.35 equiv. up to 2.8 equiv. and 10.2 equiv. per 100 ev, respectively. It is concluded that the course of the process depends on the concentration ratio of the organic substances in the ferric ion solution. (C.J.G.)

4344

LIQUID HEPTANE RADIOLYSIS BY Sr^{90} ELECTRONS. Stello Munari and Corrado Rossi (Universita, Genoa). *Ricerca sci.* **29**, 2207-12(1959) Oct. (In Italian)

The irradiation of liquid *n*-heptane at room tempera-

ture with Sr^{90} electrons produces many hydrocarbons ranging from CH_4 to $\text{C}_{14}\text{H}_{30}$. The pathways of formation of the products are explained and the reaction kinetics studied. (auth)

4345

RADIO-GAS CHROMATOGRAPHY OF NEUTRON-IRRADIATED ALKYL HALOGENIDES AND THE IDENTIFICATION OF RECOIL REACTION PRODUCTS. W. Herr, F. Schmidt, and G. Stöcklin (Max-Planck-Institut für Chemie, Mainz). *Z. anal. Chem.* **170**, 301-10(1959). (In German)

Compounds such as *n*-propylbromide were irradiated in a reactor and gas chromatographically studied. The carrier-free (n, γ) recoil products from Br^{82} , present in 10^{-8} to 10^{-11} g/g quantities, were identified. This was accomplished through the use of standard and carrier materials whereby the thermal conductivity information of the carrier is supplied by synchronous recording of carrier-free Br^{82} activity in gas-counting tubes or scintillation counters. For quantitative delivery of gaseous and liquid substances, a feeding device has been developed which is particularly convenient for handling radioactive materials. The effects of production of different recoil products by addition of aromatic amines as radial targets were studied. It was shown that only in the presence of aromatic amines also produced by intensive reactor irradiation (8 hr at 2.6×10^{11} neutrons/cm² sec) is the appearance of unsaturated Br^{82} -labeled recoil products such as vinyl bromide, 1-bromopentene, and 2-bromopentene observed. (T.R.H.)

Radiochemistry

4346 IDO-16265

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

PROTACTINIUM AND IODINE ACTIVITIES FROM IRRADIATED THORIUM. George H. Hanson. June 21, 1954. Decl. Nov. 23, 1959. 3p. Contract AT(10-1)-205. (MTRL-54-50). OTS.

Calculations were made to establish the source of observed I activity in the process water. Using the highest observed Pa activity, results show that Pa^{233} activity is too low relative to the fission product I to make Th a probable source of the activity. (C.J.G.)

4347

KINETICS AND MECHANISMS OF ISOTOPIC EXCHANGE REACTIONS OF THE HALOGENS. Rolfe H. Herber (Univ. of Illinois, Urbana). *Selecta chim.*, No. 17, 35-48(1958). (In English)

A review of literature on isotopic exchange reactions of halogens, published between March 1957 and June 1958, is presented. (C.J.G.)

Raw Materials and Feed Materials

4348 BMI-244

Battelle Memorial Inst., Columbus, Ohio.

ESTIMATED MANUFACTURING COSTS FOR THE RECOVERY OF THORIUM AND URANIUM FROM MONAZITE SAND. G. D. Calkins and R. B. Filbert, Jr. Sept. 15, 1950. Decl. Nov. 20, 1959. 20p. Contract AT-30-1-Gen-228. OTS.

Costs are estimated for the production of uranium and pure thorium from monazite concentrates. The process involves; reaction of the monazite with caustic soda, dissolu-

tion of the hydrous oxides in hydrochloric acid, separation from the bulk of the rare earths by hydroxide precipitation of thorium and uranium, and purification by solvent extraction. (auth)

4349 K-1009

Carbide and Carbon Chemicals Co. K-25 Plant, Oak Ridge, Tenn.

A LABORATORY TEST FOR EVALUATION OF URANIUM TRIOXIDES AS FEED MATERIAL. J. S. Fox. May 7, 1953. Decl. Nov. 23, 1959. 13p. Contract W-7405-eng-26. OTS.

A reactivity test for UO_3 to UF_4 was developed with a precision of 5%. The successful applications of this test to feed plant problems and its use in the development of hydration process technology for improved feed material are described. (C.J.G.)

4350 K-1081

Carbide and Carbon Chemicals Co. K-25 Plant, Oak Ridge, Tenn.

HYDROGEN REDUCTION RATES OF URANIUM TRIOXIDES AS OBTAINED WITH A THERMOBALANCE. N. C. Orrick. Dec. 18, 1953. Decl. Nov. 20, 1959. 30p. Contract W-7405-eng-26. OTS.

The H_2 reduction rates and apparent activation energies were determined for unhydrated UO_3 and for hot-slurry, dough-mixer, and cold-mix UO_3 hydrates in the temperature range of 450 to 540°C. The specific reaction rates for hydrates were consistently greater than those of the corresponding unhydrated trioxides. An increase in apparent activation energy was found on hydration. (auth)

4351 NP-8067

Eldorado Mining and Refining Ltd. Research and Development [Div.], Port Hope, Ont.

GREEN SALT AND METAL RESEARCH MONTHLY REPORT [FOR] AUGUST 1959. 23p.

The green salt plant was shut down for the month; 8 dingots were fired and 6 machined for an average of 79.17% yield. Ceramic research on UO_2 was continued; data are tabulated. Data from routine studies on metal inclusion and grain size determination are presented along with data on the form of carbon present in samples from production metal at the dingot and forged billet stage. A series of small scale firings with varied carbon content was used to study hardness variations. There was little apparent correlation. Thermal conductivity studies were continued, using Mg- UF_4 mixtures. A higher conductivity resulted than that obtained with pure UF_4 . Data are included and are being used in calculation of the temperature at 5-inch intervals on the full-scale vessel and at 15-minute intervals. (For preceding period see NP-7959.) (J.R.D.)

4352 NP-8068

Eldorado Mining and Refining Ltd. Research and Development [Div.], Port Hope, Ont.

GREEN SALT AND METAL RESEARCH MONTHLY REPORT [FOR] OCTOBER 1959. 12p.

No green salt or metal was produced during the period. Ceramic UO_2 production continued. Small-scale reductions with slow and rapid cooling were carried out. The carbon present as large inclusions increased with the slower cooling. Metallographic examination and macro etching of samples especially from type III rod program are continuing. Final calculations of heat transfer in dingot firing were made. Ceramic UO_2 studies on particle sizes to improve flow are reported. (For preceding period see NP-7950.) (J.R.D.)

4353 NYO-1333

Mallinckrodt Chemical Works, St. Louis.

URANIUM METAL BY BOMB REDUCTION. III. SLAG AND LINER STUDIES. R. Piper and A. E. Ruehle. Apr. 3, 1952. Decl. Oct. 7, 1959. 11p. Contract W-14-108-eng-8. OTS.

It is shown that the magnesium fluoride slag in dolomitic-lime lined bombs becomes contaminated with an average of about 11% of liner material. Before the bomb fires, a substantial amount of UF_4 is hydrolyzed by moisture from the liner. Laboratory experiments on modification of the liner to minimize these effects were performed. The results indicate that hydrolysis of the UF_4 can be stopped by means of a magnesium foil barrier between the liner and the charge, or by the use of a finely divided sodium metal as a water scavenger in the liner. Work on the reduction of the amount of liner material getting into the slag was directed toward the formation of a harder liner. Several materials were found which would harden the liner during heating to the bomb firing temperature of about 650°C. Among the more effective hardening agents are sodium and potassium bifluorides, sodium silicofluoride, potassium hexafluorophosphate, sodium hexameta-phosphate, and calcium, aluminum, and ammonium chlorides. A small, magnesium fluoride (slag) lined bomb was fired without melting, but with sintering, of the liner. (auth)

4354 NYO-1348

Mallinckrodt Chemical Works, St. Louis.

PILOT PLANT STUDIES OF SLAG LINERS, SECTION VII OF THE SERIES, "URANIUM METAL BY BOMB REDUCTION." T. O. Anderson. Nov. 14, 1952. Decl. Oct. 7, 1959. 34p. OTS.

The use of magnesium fluoride to replace lime as a liner in the bomb reduction of uranium tetrafluoride to metallic uranium is discussed. The magnesium fluoride used is the slag obtained from a previous bomb reduction. This slag is ground to a suitable fineness and used as a refractory liner. The primary advantage in the use of the slag liner is economy; high-priced dolomitic lime is replaced by by-product slag. Increased metal purity may also be expected. The effects of certain variables on the reaction yield are discussed. Several changes in bomb packing procedure which were found desirable are described, as well as the results of experiments employing changes found undesirable. (auth)

4355 ORNL-2853

Oak Ridge National Lab., Tenn.

PILOT PLANT PREPARATION OF THORIUM- AND THORIUM-URANIUM OXIDES. K. O. Johnsson and R. H. Winget. Dec. 22, 1959. 17p. Contract W-7405-eng-26. OTS.

Thorium oxide is formed by the calcination of thorium oxalate precipitated under carefully controlled conditions. Material is produced with mean particle diameters of 1 to 5 μ . Some of the thorium oxide had uranium added to it by decomposing uranyl carbonate on the thorium oxide followed by calcination. Most of the oxides prepared were calcined to 1000°C or more and size classified to remove particles greater than 10 μ . The oxides were prepared in 150-lb batches, with a complete cycle requiring 24 hr. (auth)

4356 TID-7581

Division of Nuclear Materials Management, AEC.

AEC AND CONTRACTOR SS MATERIALS MANAGEMENT MEETING, MAY 25-28, 1959, [GERMANTOWN, MARYLAND]. 228p. OTS.

The papers prepared and presented by the Atomic Energy

Commission and Contractor Personnel are presented. The meeting covered a broad range of problems encountered in the AEC and SS Materials Management work. (W.L.H.)

4357 TID-7581(p.1-8)

Division of Raw Materials, AEC.

AEC URANIUM PROCUREMENT PROGRAM. Jesse C. Johnson. 8p.

A brief summary is presented of the AEC uranium procurement program and of the general purchase procedures. (W.L.H.)

4358 TID-7581(p.9-29)

Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.

USE OF AUTOMATIC DATA-PROCESSING EQUIPMENT IN AN ANALYTICAL QUALITY CONTROL PROGRAM AT THE SAVANNAH RIVER PLANT. Lane V. Bailey. 21p.

The use of automatic data-processing equipment at the Savannah River Plant for SS materials accountability is described. The procedure was designed to provide continuing control over both the accuracy and the precision of analytical values reported by various laboratories. Examples and explanations of the forms, IBM card format, IBM reports, statistical worksheets, and final statistical reports for the quality control program are presented. (W.L.H.)

4359 TID-7581(p.30-6)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

ESTIMATING PRODUCT YIELDS AT HANFORD. Gerald R. Parkos. 7p.

The general concepts and methods used to develop yield equations are discussed briefly. Recent advances in nuclear technology, method of operation and computational facilities which have led to revisions in the methods used to evaluate product yields at Hanford are discussed. Among these are: Adoption of the Westcott formulation for estimating nuclear cross sections. Development of a versatile program for calculating product yields on the newly installed 709 computer. Development of methods which will permit using the results of yield calculations to estimate exposure dependent reactivity parameters. (auth)

4360 TID-7581(p.37-51)

Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn. RECOVERY OF SOURCE AND SPECIAL NUCLEAR MATERIALS. Walter H. Hoose. 15p.

The procedures for handling scrap SS materials which have been transferred to the UCNC Y-12 Plant for recovery are discussed. The application of proper segregation and packaging of such scrap to economical processing is illustrated by typical process flows. A few of the problems associated with the evaluation of scrap SS material are mentioned. (auth)

4361 TID-7581(p.52-60)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

APPLICATION OF A RATIO METHOD OF PLUTONIUM RECEIPT MEASUREMENT IN A CONTINUOUS SEPARATIONS PLANT. W. H. Johnson. 9p.

The most accurate separations plant control system was based on acceptance of U weight and determining a Pu to U ratio, thereby arriving at a Pu value essentially independent of sampling and volume considerations. A discussion is presented of the events leading up to the adoption of a ratio method for routine receipt measurement, the details of its application in a Purex continuous process, method obstacles and their elimination, and the advantages to be realized with the ratio type measurement. (W.L.H.)

4362 TID-7581(p.61-4)

National Lead Co. of Ohio, Cincinnati.

DETERMINATION OF A FACTOR ASSAY FOR URANIUM REGULI. James E. Vath. 4p.

The reduction of uranium tetrafluoride by magnesium, in the production of uranium metal, yields an aggregate of varying degrees of purity. The precision of records data is dependent upon the reliability of a nondestructive evaluation technique for routine production. The development of such a technique which has since been applied is described herein. Its importance in materials accountability applications is even more apparent in the subsequent processing steps, wherein the bias of regulus evaluation may well exceed all other measurement errors combined. (auth)

4363 TID-7581(p.65-76)

Mallinckrodt Chemical Works, St. Charles, Mo.

DEVELOPMENT OF PRESENT MATERIAL CONTROL ORGANIZATION AT MALLINCKRODT CHEMICAL WORKS. Matthew N. Kuehn and John F. Nicholson. 12p.

The methods used by Mallinckrodt Chemical Works in the management of nuclear materials are reported. (W.L.H.)

4364 TID-7581(p.85-115)

Pitkin (Lucius), Inc. Western Uranium Project, Grand Junction, Colo.

EVALUATION OF THE PURCHASE METHOD FOR THE SAMPLING AND ANALYZING OF URANIUM CONCENTRATES AT GRAND JUNCTION. Robert W. Langridge. 31p.

Evaluation of the weighing, sampling, and analytical procedures used to purchase domestic U concentrates is described. (W.L.H.)

4365 TID-7581(p.124-38)

Dow Chemical Co. Rocky Flats Plant, Denver.

ROUTINE ANALYSIS OF ENRICHED URANIUM WITH A GAMMA PULSE HEIGHT ANALYZER. Robert C. Reinke. 15p. (RFP-150).

The uranium content of solutions and solids obtained during salvage operations of enriched uranium is measured for both process control and inventory. Measurements are made with a single channel differential pulse height analyzer. The analyzer is driven by the gamma radiation detected in a well type scintillation counter. Pulse height analyses have a variation of 1 per cent on nitrate solutions containing 500 ppm to 16 per cent by weight enriched uranium. Some discard level material cannot be measured by this method because of the interference of other gamma emitters. Analysis time has been reduced to one-fourth of the time previously required by color or volumetric methods. Graphites and filter muds are analyzed directly, whereas, previously a tedious separation was required before a chemical determination could be made. (auth)

4366 TID-7581(p.139-47)

Oak Ridge National Lab., Tenn.

SS MATERIAL INPUT MEASUREMENTS TO THE ORNL POWER REACTOR FUEL REPROCESSING PILOT PLANT. George S. Sadowski. 9p.

An interim pilot plant facility for processing power reactor fuels has been put into operation at Oak Ridge National Laboratory. This facility will investigate the modifications and additions required in existing solvent extraction technology to assure its usefulness in reprocessing the newer type civilian power reactor fuels and to undertake the development of new processes which may prove more economical and simple than the existing technology. The Purex Process is used for the solvent extrac-

tion process with various types of head-end treatments to prepare the irradiated fuels to a form suitable for solvent extraction. S. S. Material input to the pilot plant is determined after the dissolved metal solution is transferred to the feed input measurement vessel. A study is currently being carried out to determine the over-all limits of error for measurements of the uranium and plutonium input. Vessel instrumentation and calibration are discussed and the results obtained from solution mixing, sampling and analytical tests for the feed input measurement vessel are presented. (auth)

4367 TID-7581(p.148-60)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

SOME STATISTICAL ASPECTS OF B-PID'S AND ENDING INVENTORIES. K. B. Stewart. 13p.

The B-PID is defined as the algebraic difference between the physical inventory and the book inventory for a material balance area and is intended to detect such things as physical loss, diversion, and gross errors of measurement or accounting. The book inventory is equal to the beginning monthly inventory plus the receipts and minus the removals for the month, so that under ideal conditions, the book inventory should equal the ending physical inventory. In actual practice at HAPO, the ending physical inventory for any month is used as the beginning inventory for the next month. (W.L.H.)

4368 TID-7581(p.161-8)

Knolls Atomic Power Lab., Schenectady, N. Y.

DETERMINATION OF TOTAL AND ISOTOPIC URANIUM ON REACTOR ELEMENT SURFACES BY ISOTOPIC DILUTION, MASS SPECTROGRAPHIC ANALYSIS. Edwin L. Shirley. 8p.

The fission recoil range of uranium in Zircaloy requires that U^{235} in the Zircaloy cladding of fuel elements be at a minimum. Since the early detection of a fuel rupture is based on the observation of fission products in the coolant stream, uranium from other sources would limit the sensitivity of these fuel defect detectors. For this and other reasons, a method was developed for the detection and isotopic assay of minute quantities of uranium in Zircaloy, steel, and other reactor materials. (auth)

4369 TID-7581(p.169-77)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

REDOX SS MATERIALS BALANCE TEST. Donald W. Hoba and R. A. Schneider. 9p.

There has developed a need to better define the reliability of nuclear materials measurements and controls in a chemical separations plant. To provide this type of information a large scale SS Material balance test with an extensive measurement program was conducted at a Hanford separations plant. The design, results, and conclusions of this test are described. (W.L.H.)

4370 TID-7581(p.178-81)

M & C Nuclear, Inc., Attleboro, Mass.

LIMITS OF ERROR IN WEIGHING. H. H. Stevens and J. Pollard. 4p.

Under conditions of single weighings, without check, it seems unlikely that limits of error can be maintained with better than 95 per cent confidence. Where many weighings are averaged together, mistakes of opposite value tend to cancel each other out. However mistakes do not appear to be distributed as in a normal distribution, and statistical methods of non-parametric nature should be employed to deal with them. Confidence statements cannot be made any

better than the over-all frequency of operator mistakes allows. Where weighing limits of error are required with 99 per cent confidence, all weighings should be double checked. A simple production method is to require a combined weighing to be made following a number of individual weighings. If the individual weighing values add up to the combined weighing value the individual weighings have been checked and can be used. It is desirable to keep a count or control chart of the frequency of mistakes caught by this system. (auth)

4371 TID-7581(p.182-9)

Oak Ridge National Lab., Tenn.

CONTROLLED-POTENTIAL COULOMETRIC ANALYSIS OF DISSOLVER SOLUTIONS OF VARIOUS REACTOR FUELS. P. F. Thomason, W. D. Shults, B. B. Hobbs, and E. L. Blevins. 8p.

The results that have been obtained on the determination of U in dissolver solutions are discussed. In controlled-potential coulometric analysis only two conditions are necessary for the accurate determination of U. The first is to carry out the electrolysis so that one reaction takes place and secondly the total current for the electrolysis must be accurately integrated. Some of the preliminary work on the determination of Pu by controlled-potential coulometric titration is briefly reported. (W.L.H.)

4372 TID-7581(p.190-7)

Goodyear Atomic Corp., Portsmouth, Ohio.

MANAGEMENT POLICY AND PHILOSOPHY PERTAINING TO CONTROLS OVER SOURCE AND SPECIAL NUCLEAR MATERIALS AT GOODYEAR ATOMIC CORPORATION, PORTSMOUTH, OHIO. Arthur H. Wernecke. 8p.

A detailed discussion is presented of policy and operating philosophies of the source of a special nuclear materials accounting organization at Goodyear Atomic Corporation. (W.L.H.)

4373 TID-7581(p.198-208)

Chicago Operations Office, AEC.

ISOTOPIC ANALYSES BY USE OF TRANSISTORIZED SCINTILLATION SPECTROMETER. Fred K. White. 11p.

The uses of the transistorized scintillation spectrometer and analytical methods as production control or quality control procedures are discussed. A new portable transistor scintillation spectrometer is described. Methods are presented for determination of U^{235} content in various fuel element foils. (W.L.H.)

4374 TID-7581(p.209-14)

M & C Nuclear, Inc., Attleboro, Mass.

A FAST AND SIMPLE QUALITATIVE METHOD OF DIFFERENTIATING ENRICHED AND NORMAL URANIUM BY GAMMA-RAY SPECTROMETRY. L. A. Sarkes, R. J. Murphy, and K. C. Duffy. 6p.

A method using gamma spectroscopy has shown that reliable data can be obtained for U^{235} determination all the way from depleted to highly enriched. (W.L.H.)

4375 TID-7581(p.215-23)

Westinghouse Electric Corp. Bettis Atomic Power Div., Pittsburgh.

METAL SPACE FRAME SHIPPING CONTAINERS. C. W. Hughes. 9p.

The development of inside and outside shipping containers are reported. One container was built out of welded steel angle. The cost and length of time for construction of this container showed that another method was needed. A container built of pre-slotted steel angle proved to be inexpensive, quickly assembled, and light in weight. A series of drop and vibration tests was performed on the pre-

slotted steel angle containers. They were found to perform satisfactorily. Three different types of inner containers are discussed. (W.L.H.)

4376

AN APPROACH TO THE THEORETICAL TREATMENT OF MAGNETIC CONCENTRATION. Erkki Laurila. *Ann. Acad. Sci. Fennicae Ser. A VI*, No. 8, 1-12(1958).

A theoretical treatment of the magnetic concentration of ores in magnetic separators is given. The results, plotted as the concentration of magnetic material in the powder vs. number of separations, are compared to experimental data. The agreement between experimental and theoretical values is shown to depend on particle size. (C.J.G.)

4377

JAPAN'S FIRST URANIUM REFINERY. A CYCLIC PULSED ION-EXCHANGE COLUMN IS THE MAIN MEANS OF PURIFYING THE URANIUM SOLUTION. Kozaburo Takahashi (Atomic Fuel Corp. of Japan). *Brit. Chem. Eng.* 4, 678-9(1959) Dec.

A simplified flowsheet and process description is given for the Excer process which is to be utilized in a 30-kg pilot plant. (C.J.G.)

4378

SINTERING OF URANIUM OXIDE IN HYDROGEN AT 1350°C. A. Bel, R. Delmas, and B. François (Centre d'Études Nucléaires, Saclay, France). *J. Nuclear Materials* 1, 259-70(1959) Oct. (In French)

Sintering oxides of large specific surface area in argon produces a more coarse-grained product (5 to 10 μ) than does hydrogen sintering; the density is the same in each case. Departure from stoichiometric composition of the powders does not appear to influence the density of the sintered compact. The sintering, in hydrogen, of various oxides of large specific surface area, obtained from ammonium uranate and uranium peroxide, was studied in a systematic way. With a given specific surface area, the final density varied as a function of the sintering temperature, with a maximum density for a particular temperature. This temperature is lowest when the specific surface area of the powder is the greatest. A process is described for the preparation of uranium oxide powder from ammonium uranate and its sintering in hydrogen at 1350°C; in this way a fine-grained product of density 10.6 can be obtained. (auth)

4379

THE FLUORINATION OF PLUTONIUM TETRAFLUORIDE AND PLUTONIUM DIOXIDE BY FLUORINE. M. J. Steindler, D. V. Steidl, and R. K. Steunenberg (Argonne National Lab., Lemont, Ill.). *Nuclear Sci. and Eng.* 6, 333-40(1959) Oct.

The conversion of plutonium tetrafluoride and plutonium dioxide to the hexafluoride by elemental fluorine was investigated in a flow system at temperatures between 100 and 600°C. The partial pressure of fluorine used was varied from 0.25 to 1.0 atmosphere. The rates of fluorination were dependent on the source of the starting material, probably due to differences in particle size. Activation energies of the reaction were between 10 and 12 kcal per mole. The reactions are believed to show promise for process application in the recovery of plutonium from nuclear reactor fuels. (auth)

Separation Processes

4380 CF-59-4-9

Oak Ridge National Lab., Tenn.

RECOVERY OF URANIUM FROM RESIDUES PRODUCED

IN HYDROCHLORINATION OF NUCLEAR FUEL ALLOYS. T. A. Gens. Apr. 10, 1959. 9p. Contract [W-7405-eng-26]. OTS.

Chlorination at 550 to 600°C of Zircex residues with carbon tetrachloride resulted in greater than 99.99% recovery of the uranium. Both the hydrochlorination residue and the solids which remain after leaching the hydrochlorination residue with nitric acid were chlorinated with similar results. By this technique, loss of 1 to 6% of the uranium to the nitric acid insoluble residue, which occurs in simple hydrochlorination and dissolution of STR fuel, is avoided. Other advantages include reduced corrosion and the elimination of possible explosions between U-Zr alloys and nitric acid. A modified flowsheet is proposed. (auth)

4381 DP-399

Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.

DISSOLUTION OF THORIUM IN MIXTURES OF HNO₃ AND HF. David G. Karraker. Sept. 1959. 16p. Contract AT(07-2)-1. OTS.

Laboratory measurements of dissolution rates of thorium in mixtures of nitric and hydrofluoric acids show that thorium can be dissolved with practicable time cycles in large-scale processing. The corrosion of stainless steel during the dissolution of thorium is acceptable, except that when the thorium is coated with Al-Si alloy, frequently used as a bonding material for aluminum cans, severe local corrosion of the stainless steel occurs at areas of contact with residual Al-Si. This contact corrosion does not occur when the cans are hot-press-bonded to the thorium without Al-Si. (auth)

4382 DP-439

Du Pont de Nemours (E.I.) & Co. Savannah River Lab., Aiken, S. C.

REPROCESSING OF POWER REACTOR FUELS. Quarterly Progress Report No. 8 [for] July 1 to October 1, 1959. E. S. Occhipinti, comp. Nov. 1959. 10p. Contract AT(07-2)-1. OTS.

Niobium can be used as an inert metal connector for electrolytic dissolution of stainless steel; zirconium metal and zirconium-10 wt.% uranium alloy can be electrolytically disintegrated in 8 to 13M HNO₃. Criticality calculations show that it is safe to dissolve a group of four sub-assemblies of PRDC elements in the large plant dissolvers, provided that the subassemblies are held in a single row. (auth)

4383 HW-32100

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

NOTES PERTAINING TO RECUPLEX PRODUCT EVAPORATION. R. A. Pugh. Apr. 28, 1954. Decl. Nov. 23, 1959. 9p. Contract W-31-109-Eng-52. OTS.

A red-brown liquid formed during the evaporation of simulated Recuplex product solutions containing plutonium, nitric acid, carbon tetrachloride, and tributyl phosphate (TBP). The liquid is soluble in carbon tetrachloride. Concentration of solutions containing a TBP to plutonyl nitrate weight ratio of 0.15 or greater to a pot temperature of 150°C caused reactions which produced enough heat to bring the pot contents to a red heat with copious evolution of gases. Evaporation path curves and boiling point data were obtained from batch evaporations with minimum reflux and are presented. Polymeric plutonium(IV) was formed upon concentrating plutonium nitrate solutions of low nitric acid content. The region of polymer formation was defined and is presented. (auth)

4384 HW-40810

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

THE SEPARATION OF URANIUM AND PLUTONIUM ISOTOPES IN CHEMICAL EXCHANGE SYSTEMS. H. T. Hahn. May 16, 1955. Decl. Nov. 23, 1959. 18p. OTS.

The theory and results of chemical exchange experiments for separation of Pu and U isotopes are presented. Solvent extraction systems were studied in both aqueous and organic media. Chemical exchange systems are proposed which could yield high separation factors. (W.L.H.)

4385 HW-61662

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

POWER REACTOR FUELS REPROCESSING. PROGRESS REPORT ON CORROSION STUDIES. R. F. Maness. Aug. 26, 1959. 57p. Contract AT(45-1)-1350. OTS.

Work is reported on corrosion studies of candidate materials of construction for equipment for the dissolution of Zircaloy cladding in NH_4F - NH_4NO_3 solutions, the total dissolution of stainless steel clad fuels in HNO_3 -HF solutions, and the dissolution of stainless steel cladding in dilute H_2SO_4 . A single material of construction which could be used for a processing complex which would handle all of the low-enrichment fuels concerned was searched for. In the Zirflex Process (NH_4F - NH_4NO_3) the 300 series stainless steels, vacuum-melted Hastelloy-F, Carpenter 20, Nio-nel, Haynes 25, and Incoloy 804 have satisfactory corrosion resistance to solutions involved in the dissolution of Zr or Zircaloy claddings. Satisfactory dissolution rates for 304-L stainless steel cladding are obtained in the Niflex Process ($1\text{M}\text{HNO}_3$ - 2MHF) solutions. The minimum practical fluoride to stainless steel ratio is about five. Among many materials studied, vacuum-melted Hastelloy-F offers the best corrosion resistance to HNO_3 -HF solutions encountered during decladding. In the Sulfex Process (H_2SO_4) dissolution rates for both annealed 304-L and 347 stainless steel in 3 to 3 M H_2SO_4 are from 5 to 10 mils per hour. Vacuum-melted Hastelloy-F and Ni-o-nel show adequate corrosion resistance to the H_2SO_4 -stainless steel solutions concerned in H_2SO_4 decladding. During U or UO_2 core dissolution in HNO_3 following decladding, some sulfate (sulfex decladding) or (fluoride zirflex decladding) will be present due to incomplete rinsing or to the presence of solids (UF_4). Residual sulfate in the concentration range has no significant effect on the corrosion of 304-L stainless steel or vacuum-melted Hastelloy-F by HNO_3 . Fluoride present will increase the corrosion potential but can be effectively complexed by Al. Corrosion rates of 304-L, vacuum-melted Hastelloy-F, and Ni-o-nel in HNO_3 solutions are not markedly increased by low concentration (0.1 to 0.3M) of ferric nitrate. However, at higher concentrations (~ 1 M) corrosion of an intergranular nature is severe. (W.L.H.)

4386 IDO-14486

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

THE DETERMINATION OF EXCESSIVE EMULSIFICATION BY COALESCENCE BEHAVIOR MEASUREMENTS. O. W. Parrett. Nov. 25, 1959. 24p. Contract AT(10-1)-205. OTS.

The development of a remotely operated device for determining the coalescence times of plant process streams suspected of containing surfactants such as silicic compounds and fission product zirconium compounds is described. A general correlation between the coalescence times of pilot plant extraction column aluminum nitrate

feeds and 3.25 percent tributyl phosphate extractant streams and the observations of column behavior of these streams is demonstrated. The application of the coalescence test to plant streams is given. (auth)

4387 K-1078

Carbide and Carbon Chemicals Co. K-25 Plant, Oak Ridge, Tenn.

A SIMPLIFIED ANALYTICAL METHOD FOR SEPARATING TRACES OF FISSION PRODUCTS FROM URANIUM AND THORIUM (UX_1). C. A. Kienberger and A. R. Flynn. Dec. 2, 1953. Decl. Nov. 23, 1959. 14p. Contract W-7405-eng-26. OTS.

A simplified analytical solvent extraction method for separating traces of fission products as a group from uranium and thorium is described. This method holds the fission products in the aqueous solution by the addition of hydroxylamine hydrochloride as the reducing agent and citric acid. The uranium and thorium were extracted with 50% tributylphosphate-varsol solution, using aluminum nitrate as a salting agent. This method is rapid and readily adaptable to routine measurements of the beta and/or gamma activity of the fission products in uranium recovered from pile waste. (auth)

4388 MLM-609

Mound Lab., Miamisburg, Ohio.

THE CHEMICAL ENGINEERING OF THE RADIUM PROCESS. Final Report. H. L. Rawlings. June 8, 1951. Decl. Dec. 2, 1959. 56p. Contract AT-33-1-GEN-53. OTS.

A description is given of the process for the removal of radium from Pb-Ba gangue as $\text{Ra}(\text{NO}_3)_2$. Process flow-sheets show the equipment needed for waste disposal, nitric acid recovery, and minimum storage and reagent-preparation facilities. Cost estimates are given for a pilot plant and a full scale production plant. (C.J.G.)

4389 ORNL-2713

Oak Ridge National Lab., Tenn.

MODIFIED ZIRFLEX PROCESS FOR DISSOLUTION OF ZIRCONIUM- AND NIOBIUM-BEARING NUCLEAR FUELS IN AQUEOUS FLUORIDE SOLUTIONS: LABORATORY DEVELOPMENT. T. A. Gens and F. G. Baird. Dec. 22, 1959. 29p. Contract W-7405-eng-26. OTS.

Modified Zirflex process flowsheets were developed for recovering uranium from the newer power reactor fuel alloys after discharge from the reactor. The STR (1% U-97% Zr-2% Sn) and EBWR Core-1 (93.5% U-5% Zr-1.5% Nb clad in Zircaloy-2) fuels are used as examples of low- and high-uranium fuels, respectively. A dissolvent of 6 M NH_4F yields a solution of zirconium and a precipitate of ammonium uranous fluoride. In one process, ammonium hydroxide is added to produce insoluble hydrous oxides of uranium, zirconium, and niobium. The NH_4F - NH_4OH supernatant is removed by filtration, partially evaporated, and recycled as dissolvent. The uranium and zirconium oxides are dissolved in nitric acid to yield a solvent extraction feed solution of low fluoride content. In an alternative process nitric acid and aluminum nitrate are added to the ammonium fluoride fuel solution to oxidize U(IV) to soluble U(VI) and prepare a stable solution suitable for solvent extraction. Chromic acid is also added in the case of the STR fuel. In a variation of this flowsheet for the EBWR fuel, only enough 6 M NH_4F is added to dissolve the cladding. Nitric acid and aluminum nitrate are then added to dissolve the core. Insoluble niobic oxide, which carries about 0.03% of the uranium from the EBWR fuel, is removed by filtration from the solvent extraction feed solutions in the EBWR flowsheets. (auth)

4390

DEVELOPMENT BY DISPLACEMENT ON ION EXCHANGERS. SEPARATION OF MORE THAN TWO IONS. C. Cornet and J. Huré (Commissariat à l'Énergie Atomique, Paris) and J. Coursier (Laboratoire de Chimie Analytique de l'École Supérieure de Physique et de Chimie, Paris). Anal. Chim. Acta **19**, 259-66(1958) Sept. (In French)

In the separation of several substances by displacement development, the minimum distance that the band must travel to obtain a separation of the solutes into zones is calculated. The method has been applied to the separation of lithium, sodium, ammonium, and potassium ions on Dowex-50 resin, using calcium ions as the developer. (auth)

4391

ATOMIC FUEL PROCESSING. PART II. HANFORD: ATOMS FOR PEACE. Chem. Eng. **67**, 113-18(1960) Jan. 11.

The safety procedures involved in receiving and storing a spent reactor core are discussed. Mechanical processing procedures such as sawing and shearing are described. The chemical processing facilities include a dissolver for removal of cladding and conversion of the fuel cores to an aqueous nitrate solution and equipment for recovering core material in the cladding removal solutions. The specific mechanical-chemical processes used in aluminum, stainless steel, and Zircaloy cladding removal are described. Fuel processing after cladding removal of UO_2 and U-Mo dissolutions are discussed. Waste disposal and criticality problems are outlined. (C.J.G.)

4392

FAST RADIOCHEMICAL ISOLATION OF FISSION PRODUCT ARSENIC AND THE INDEPENDENT YIELD OF ARSENIC-78 IN THERMAL NEUTRON FISSION OF URANIUM-235. A. Kjelberg and A. C. Pappas (Univ. of Oslo, Blindern, Norway). J. Inorg. & Nuclear Chem. **11**, 173-80 (1959) Oct.

The independent yield of 91.0 min As^{78} in thermal neutron fission of U^{235} was redetermined using a radiochemical method for rapid isolation of arsenic. Special precautions were taken in order to ensure a good and fast separation from its precursor germanium. The value obtained $(1.7 \pm 0.5) \times 10^{-4} \%$ is about one order of magnitude lower than the old value and fits the charge distribution curve. (auth)

4393

PREPARATION OF Nb^{95} -FREE Zr^{95} BY TTA EXTRACTION. H. L. Scherff and G. Herrmann (Universität, Mainz). J. Inorg. & Nuclear Chem. **11**, 247-8(1959) Oct. (In German)

The conditions for the extraction of Zr^{95} from a mixture of Zr^{95} and Nb^{95} with TTA (thenoyltrifluoroacetone) and back extraction with HCl was investigated. The distribution coefficient was determined in 0.10 and 0.05 M TTA in benzol and 0.05 M TTA in xylol as a function of increasing HCl concentration. The results showed a sharp increase in the distribution coefficient with HCl concentration over about 6 N. The cause of the increased distribution coefficient was attributed to an ion exchange mechanism resulting in the preferential formation of a negatively charged ZrCl complex. The method, previously suggested, of preparing a stock solution of Zr^{95} in TTA-benzol, storing it in HNO_3 or HCl, and extracting the Zr^{95} as needed by multiple washing with 2 N HCl. With increasing age of the stock solution, the extraction time is increased and the method is not suitable for the preparation of pure Zr^{95} . (J.S.R.)

4394

ION-EXCHANGE BEHAVIOR OF MENDELEVIVUM. R. C. Gatti, L. Phillips, T. Sikkeland, M. L. Muga, and S. G. Thompson (Univ. of California, Berkeley). J. Inorg. & Nuclear Chem. **11**, 251-3(1959) Oct.

The elution position of mendelevium from cation-exchange resin columns was determined relative to the peaks of actinide and lanthanide elements. A separation factor (relative to curium) for mendelevium by ammonium α -hydroxyisobutyrate eluant was determined to be 0.050 ± 0.005 . (C.J.G.)

4395

SEPARATION OF CARRIER-FREE INDIUM-111 FROM SILVER BY ION EXCHANGE. G. de Pasquali, E. Von Goeler, and R. N. Peacock (Univ. of Illinois, Urbana). J. Inorg. & Nuclear Chem. **11**, 257(1959) Oct.

In^{111} was obtained by bombarding an Ag target with alpha particles. The target was anodically dissolved in dilute HNO_3 , the solution evaporated to dryness, and the residue dissolved in 4N KCN. The resulting solution was passed through a small anion exchange column previously treated with 4N KCN. After washing with 4N KCN solution and water the indium was eluted with 1N HCl. After a second purification by the above cycle, In^{111} was obtained with less than 0.3% impurities. (C.J.G.)

4396

ON THE REMOVAL OF VOLATILE FISSION PRODUCTS FROM URANIUM-BISMUTH REACTOR FUELS. Orrington E. Dwyer and Allen M. Eshaya (Brookhaven National Lab., Upton, N. Y.). Nuclear Sci. and Eng. **6**, 350-60(1959) Oct.

In the Liquid Metal Fuel Reactor (LMFR) the fuel is a dilute solution of U, Mg, and Zr in bismuth. At the operating fuel temperatures (400 to 550°C), the volatile fission products (FPV's), which represent about 25% of the total by weight, are mostly the noble gases Kr and Xe with small amounts of the halogen fission products Br and I. Owing to the facts that the LMFR is a thermal breeder reactor and that the 9.13-hr Xe^{135} isotope has a 2.7×10^6 -barn thermal cross section, the concentration of FPV's in the fuel and in the core must be kept very low for good neutron economy. For a 1% reactor poisoning level, and assuming no Xe adsorbed on or absorbed in the graphite, the concentrations of 9.13-hr Xe^{135} and total Xe in the fuel are estimated to be about 1.5 and 13 parts per billion, respectively, for a typical commercial plant. Complete isotopic compositions of the volatile fission products and poison levels for different removal rates are presented. The effect of various degrees of volatilization of the iodine and bromine on these factors are also shown. Xe represents over 80% by weight of the FPV's. Both Xe and its precursor, iodine, have strong tendencies to adsorb on unwetted surfaces and to penetrate graphite, the moderator material in the reactor core. Immobilization of Xe in the core would present a problem from the standpoint of reactor poisoning. Experimental results are presented to show the extents to which both iodine and Xe adsorb on steel and graphite and penetrate graphite. It appears that the Xe problem is not so much one of removing it from the fuel in a desorber as it is in preventing it from collecting on graphite surfaces in the core. (auth)

4397

THE MELT REFINING OF IRRADIATED URANIUM: APPLICATION TO EBR-II FAST REACTOR FUEL. I. INTRODUCTION. L. Burris, H. M. Feder, S. Lawroski, W. A. Rodger, and R. C. Vogel (Argonne National Lab., Lemont, Ill.). Nuclear Sci. and Eng. **6**, 493-5(1959) Dec.

A process for recycling plutonium and uranium alloy fuels is described; it involves melting and liquating the alloys in ceramic crucibles and casting the partially purified metals. Its particular merit is the rapid turnover of a fuel suitable for a fast reactor. A pilot plant, now under construction, will operate in a closed cycle with the EBR-II, and will permit technical and economic evaluation. (auth)

4398

THE MELT REFINING OF IRRADIATED URANIUM: APPLICATION TO EBR-II FAST REACTOR FUEL. II. EXPERIMENTAL FURNACES. G. J. Bernstein, G. A. Bennett, N. R. Chellew, and V. G. Trice, Jr. (Argonne National Lab., Lemont, Ill.). Nuclear Sci. and Eng. **6**, 496-500(1959) Dec.

Six experimental furnaces used for the development of the melt refining process are described. These furnaces permitted uranium or its alloys to be melted without atmospheric contamination while their properties (surface tension, reactions with refractory oxides, decontaminability, castability, etc.) were under study. (auth)

4399

THE MELT REFINING OF IRRADIATED URANIUM: APPLICATION TO EBR-II FAST REACTOR FUEL. III. PREPARATION OF EXPERIMENTAL ALLOYS. D. C. Hampson, G. A. Bennett, and N. R. Chellew (Argonne National Lab., Lemont, Ill.). Nuclear Sci. and Eng. **6**, 501-3(1959) Dec.

A complex alloy of uranium with zirconium, niobium, molybdenum, ruthenium, and palladium (uranium-fissium) was prepared by induction co-melting and casting. Alloying with plutonium and cerium was also studied. Good recoveries of the alloying elements in homogeneous ingots was achieved. The techniques established by this study are being used to prepare the core material for EBR-II. (auth)

4400

THE MELT REFINING OF IRRADIATED URANIUM: APPLICATION TO EBR-II FAST REACTOR FUEL. IV. INTERACTION OF URANIUM AND ITS ALLOYS WITH REFRACTORY OXIDES. C. L. Rosen, N. R. Chellew, and H. M. Feder (Argonne National Lab., Lemont, Ill.). Nuclear Sci. and Eng. **6**, 504-10(1959) Dec.

Sessile drops of liquid uranium on five refractory oxide substrates were studied photographically. The volume expansion on melting ($\sim 3\%$), the contact angles ($135 \pm 3^\circ$ in each case), and the surface tension of the liquid ($826 \pm 10\%$ dynes/cm) were determined. The reactions of liquid uranium with alumina or magnesia proceed stoichiometrically to the expected products. The reactions with zirconia, thorium, and beryllia yield oxygen-deficient substrates and only small amounts of the corresponding metal in solution. The kinetics and reaction mechanism are discussed. Some effects of alloying on these phenomena are also noted. (auth)

4401

THE MELT REFINING OF IRRADIATED URANIUM: APPLICATION TO EBR-II FAST REACTOR FUEL. V. YIELD OF FISSIONABLE MATERIAL UPON POURING. G. A. Bennett, N. R. Chellew, and D. C. Hampson (Argonne National Lab., Lemont, Ill.). Nuclear Sci. and Eng. **6**, 511-13(1959) Dec.

The recovery of metal as cast ingot after melt refining was studied as a function of the size and geometry of the crucible, the time-temperature cycle, the purity of the furnace atmosphere, and the nonmetal impurities present

in the charge. The conditions chosen for the pilot plant operation ensure the attainment of the required recovery and recycle of fuel of steady-state composition. (auth)

4402

PRECIPITATION CONDITIONS FOR TRACE AMOUNTS OF PLUTONIUM WITH MANDELIC ACID AS PRECIPITATION REAGENT. E. Merz (Max-Planck-Institut für Chemie, Mainz). Z. anal. Chem. **166**, 417-22(1959). (In German)

Mandelic acid and its derivative p-bromomandelic acid were found to be suitable precipitation reagents for tri- and tetravalent Pu ions. Pu^{3+} is precipitated by both reagents from very weak acid solutions together with Yb carrier. Pu^{4+} on the other hand is precipitated almost completely from strongly acid solutions with Zr carrier while Pu^{3+} remains in solution. Under these conditions Pu^{6+} is neither in neutral nor in acid solution taken down. This new reagent is so effective that certain valences of Pu can be separated from each other. Moreover it is possible to separate Pu^{4+} from U in weakly acid solutions. The p-bromomandelic acid is superior to D, L-mandelic acid both in speed and completeness of precipitation. (T.R.H.)

4403

ION EXCHANGE SEPARATION OF SOME LIGHT RARE EARTHS BY ELUTION WITH SODIUM TRIPHOSPHATE. P. R. Subbaraman, K. S. Rajan, and J. Gupta (National Chemical Lab., Poona, India). Z. anorg. u. Allgem. Chem. **301**, 261-6(1959) Oct. (In English)

Sodium triphosphate has been used probably for the first time for the ion-exchange separation of rare earths. A complexing elution on a cation exchanger with sodium triphosphate has given a more satisfactory separation of the light rare earths than the elution of their triphosphato complexes on an anion exchanger with dilute mineral acids. Equilibration studies with Amberlite IRA-400 resin indicate that the rare earths form anionic complexes with sodium triphosphate over a wide range of p_H . (auth)

4404

DISTRIBUTION OF PLUTONIUM IN SOLVENT EXTRACTION BY TRIBUTYLPHOSPHATE. A. M. Rozen and E. I. Moiseenko. Zhur. Neorg. Khim. **4**, 1209-14(1959) May. (In Russian)

Distribution coefficients of Pu(IV) and Pu(VI) during solvent extraction by 20% tributylphosphate solution in kerosene were measured. The acidity of the aqueous phase varied from 0.1 to 10 mole/l, the uranium content from 0 to 400 g/l, and the uranium content from 0 to 400 g/l. A considerable drop of activity factors in Pu(IV) was observed with the increase of acidity. (R.V.J.)

4405

EXTRACTION OF THORIUM FROM AQUEOUS SOLUTION. Walter Ryan (to United Kingdom Atomic Energy Authority). British Patent 824,396. Nov. 25, 1959.

Solvent extraction of Th from barren acidic aqueous liquor is described. The pH is adjusted to between 1.5 and 2.5 and the solution is contacted with di-(2-ethylhexyl) phosphoric acid. The Th is removed from the organic phase by H_2SO_4 or HCl and precipitated. The procedure is especially suited to sulfate liquors. (T.R.H.)

4406

URANIUM AND ZIRCONIUM RECOVERY AS URANIUM HEXAFLUORIDE AND ZIRCONIUM FLUORIDE FROM ALLOYS CONTAINING THESE ELEMENTS. (to U. S. Atomic Energy Commission). British Patent 824,579. Dec. 2, 1959.

A fluoride volatility process for recovery of U and Zr from U-Zr alloy is offered. The metal is placed in an equimolar ZrF_4 -NaF fused bath and dissolved by sparging with BrF_5 , BrF_3 , ClF_3 or F_2 , the first being preferred. The dissolution takes 3 to 6 hours at 500-600°C. About 5 mole % PbF_2 speeded up the dissolution. The UF_6 formed is volatilized and separated. (T.R.H.)

4407

RECOVERY OF URANIUM FROM LOW GRADE URANIUM BEARING ORES. (to U. S. Atomic Energy Commission). British Patent 825,100. Dec. 9, 1959.

A process is presented for U recovery from Chattanooga Shale. The shale is retorted to recover organic matter, chlorinated, chlorides vaporized, and U chlorides taken up in molten alkali metal chloride bath from which it is separated. Chlorination is best with Cl_2 at 600 to 1000°C. The chloride vapor is passed through fused KCl at 900 to 950°C. The U is recovered from the cooled salt by acidification and solvent extraction. The process is economically feasible because Fe and Al and the Cl are recovered, and gases from the retort are burnt to provide heat for the process. (T.R.H.)

4408

IMPROVEMENTS IN OR RELATING TO FRACTIONAL EXTRACTION PROCESSES. David William Fosbury (to United Kingdom Atomic Energy Authority). British Patent 825,208. Dec. 9, 1959.

A fractional batch solvent extraction process is described. (T.R.H.)

ENGINEERING AND EQUIPMENT

General and Miscellaneous

4409 TID-4100(1st Rev., Suppl. 5)

Technical Information Service Extension, AEC. ENGINEERING MATERIALS LIST. A Catalog of Drawings, Photographs, and Specifications Released by the United States Atomic Energy Commission. Richard E. C. Duthie, ed. Nov. 1959. 30p.

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Engineering materials are listed as engineering equipment, hot laboratory equipment, instruments, metallurgical equipment and process furnaces, nuclear-radiation equipment, and nuclear reactors and facilities. The listings are limited to the materials included in this supplement. The indexes enable the user to locate materials by names of the organizations which originated the material, by subjects, and by original drawing identification numbers. (J.R.D.)

4410 AERE-Trans-838

THE RATE OF PUMPING DOWN IN HIGH-VACUUM SYSTEMS. T. Kraus. Translated by F. Hudswell (U.K.A.E.A. Atomic Energy Research Establishment) from *Vakuum-Tech.* 2, No. 2, 39-43(1959). 13p.

The rate of pumping down in the high-vacuum range is dependent on the decay of various gas-production processes which take place at the surfaces. When a given process of gas formation which varies with time prevails in a vessel, then the pumping time t required to attain a given pressure p can generally be obtained by a kinetic consideration of the processes by means of the equation $t = [(F/S)(\phi/p - P_E)]^n - t_0$. F is the surface area of the specimen, S the velocity of suction of the pump, P_E the final pressure due to the steady processes and t_0 a constant depending on the initial conditions. The type of gas formation is identified from the value of the exponent n and its intensity from the value of

the material-dependent constant ϕ . The experimental results indicate that the action of the most important gas-formation processes in high-vacuum systems may be represented with sufficient accuracy by integral exponents n , for example, by $n = 1$ for adsorption processes, which in the ideal case can be reduced to a Temkin isotherm, or by $n = 2$ for diffusion processes which obey the law of diffusion over "almost infinite" regions of the specimen. For metal vessels, which become contaminated with inorganic substances during operation, a simple pumping-time law is applicable on substituting VP_A (with $n = 1$) for the product $F\phi$ in the above equation. The quantity P_A here represents a characteristic pressure, which in its turn indicates the upper limit of validity of the law. Its value is dependent on the kind and condition of the system but (to a first approximation) not on the volume of the vessel, V . Average values of P_A are 10^{-2} mm Hg for clean and a few times 10^{-1} mm Hg for contaminated systems. (auth)

4411

THE USE OF RADIOACTIVE MARKERS IN PIPELINE SCRAPERS. LOCATING A JAMMED SCRAPER IN A PIPELINE USING A COBALT-60 SOURCE. Anne M. Ball, J. C. Daglish, and S. Jefferson (United Kingdom Atomic Energy Research Establishment, Harwell, Berks, Eng.). *Brit. Chem. Eng.* 4, 665-7(1959) Dec.

The use of a 100 mc- Co^{60} source for locating a jammed scraper in a pipeline is discussed. The Co^{60} marker is enclosed in an aluminum alloy capsule and is easily detected through 3 ft-6 in. of medium-density earth with a rate-meter. (C.J.G.)

4412

THE CALCULATION OF DRIVING PRESSURES AND NATURAL CIRCULATION IN STEAM BOILERS AND EVAPORATORS. G. D. Rabinovich (Inst. of Power Engineering, Academy of Science, Belorussia SSR, Minsk). *Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R.* 2, No. 7, 67-74(1959) July. (In Russian)

It is shown that the method accepted at the present time for calculating circulation does not take account of a number of factors which affect this process. An attempt is made to approach the solution of the problem of the calculation of natural circulation from a position based on the fundamental equations of heat exchange. As a result, simple relationships are obtained for the determination of the rate of circulation in a simple closed contour. (auth)

4413

IMPROVEMENTS IN OR RELATING TO WINCH APPARATUS ESPECIALLY FOR USE IN NUCLEAR REACTORS. Donald Mason Sutherland, Harold Proctor, John Kenneth Jobbins, and Edwin Arthur White (to United Kingdom Atomic Energy Authority). British Patent 817,999. Aug. 12, 1959.

A winch for use in reactors is described. A flexible cable is wound in a flat spiral on a drum geared to an electric motor. A biased roller is provided for remote measurement of the cable. A tension-sensitive switch turns off the drive motor upon relaxation of tension. An eddy-current brake device to limit the speed of fall of a control rod in emergency conditions is provided. (T.R.H.)

4414

IMPROVEMENTS IN OR RELATING TO REVERSIBLE STACKING AND UNSTACKING MECHANISMS FOR A SERIES OF FLAT BODIES. John Christopher Howard Gelsow (to United Kingdom Atomic Energy Authority). British Patent 818,015. Aug. 12, 1959.

A device for storing and handling flat radioactive

samples for a Geiger counter is described. The mechanism stacks or unstacks sample-plates or absorber-plates by means of two cylindrical cams which rotate to lift the stack and allow another to slide under. (T.R.H.)

4415

IMPROVEMENTS IN OR RELATING TO MEANS FOR SORTING OBJECTS ACCORDING TO A CRITICAL DIMENSION. Arthur James Harris. (to United Kingdom Atomic Energy Authority). British Patent 818,398. Aug. 19, 1959.

A device is described which sorts cylindrical tokens into convenient groups for replacement in suitable containers or racks. The sorting is done by passing the tokens through a series of measuring slots to select by size. It is useful in sorting badges or identification tokens. (T.R.H.)

4416

IMPROVEMENTS IN OR RELATING TO VALVES FOR CONDUITS CARRYING FLUIDS. Albert Henry James Thomas (to United Kingdom Atomic Energy Authority). British Patent 818,501. Aug. 19, 1959.

A valve design is presented which has all operating parts outside the valve chamber for ease of maintenance and repair and to facilitate use with corrosive fluids. The movable plug is mounted on a central axle and can be rotated to any of several ports. The valve is then closed by moving the central shaft by screws toward the port which the plug faces. (T.R.H.)

Heat Transfer and Fluid Flow

4417 KAPL-RDTR-327 (Pt. II)

Knolls Atomic Power Lab., Schenectady, N. Y.
COLD STARTUP HEAT TRANSFER FOR $7\frac{1}{4}$ -INCH PITCH RIBBONS WITH LOCAL AND BULK BOILING. J. L. Nash. Sept. 23, 1959. 80p. OTS.

The object of the test was to measure fuel element temperatures at low pressures similar to those encountered during reactor startup. More specifically, this particular section of Test 327 was designed to measure fuel element temperatures in local and bulk boiling. The data obtained were correlated using a Jens-Lottes type equation and the heat flux as variables with the absolute pressure as a parameter. (W.D.M.)

4418

HEAT TRANSFER BY RADIATION THROUGH POROUS INSULATIONS. Bert K. Larkin and Stuart W. Churchill (Univ. of Michigan, Ann Arbor). *A.I.Ch.E. Journal* 5, 467-74(1959) Dec.

Radiant transfer through fibrous and foamed insulating materials was investigated theoretically and experimentally. Transmission measurements were made under isothermal conditions with a black-body source varying from 200 to 800°F. Bulk density and fiber and pore size were also varied. These data were interpreted successfully in terms of a simple theoretical model. The results provide design information and define the contributions of the several mechanisms of transfer. (auth)

4419

RADIATIVE AND CONDUCTIVE HEAT TRANSFER IN A QUIESCENT GAS-SOLID BED OF PARTICLES. THEORY AND EXPERIMENT. F. B. Hill and R. H. Wilhelm (Princeton Univ., N. J.). *A.I.Ch.E. Journal* 5, 486-96 (1959) Dec.

A study of radiation as a contributing mechanism in the transfer of heat between discrete solid particles is

presented. A theory for transfer in such systems is generalized to include planar-, spherical-, and cylindrical-bed geometries; because of the particulate nature of the system the generalization is given in terms of finite-difference equations. Transfer experiments were performed in a quiescent cylindrical bed with an axial heat source and a cylindrical containing-wall sink. Heat fluxes and radial-temperature profiles were measured. As the experiments were arranged, only modest temperature gradients were established between source and sink, but the ambient sink temperature was taken in steps from 100 to 1,000°C. For a bed of 3.8-mm.-diameter alumina spheres the ratio of heat transferred by radiation to that transferred by conduction was estimated to increase with average bed temperature from the order of 0.1 at 100°C. to 1.2 at 1,000°C. The effects of temperature on bed reflectivity and transmissivity and on apparent boundary-temperature discontinuities are discussed. (auth)

4420

HEAT TRANSFER TO MOVING FLUIDS. Jesse Coates and Bernard S. Pressburg (Louisiana State Univ., Baton Rouge). *Chem. Eng.* 66, No. 26, 67-72(1959) Dec. 28.

A review is presented on methods of calculating heat transfer to moving fluids. Correlations are given for heat transfer coefficients for fluids undergoing no change of phase, both inside and outside a conduit. Various resistances encountered in convective heat transfer are given. The use of dimensional analysis to correlate data is discussed, with correlations for low Reynolds numbers. Film coefficients for phase changes are discussed. (C.J.G.)

4421

HEAT EXCHANGE OF A PLATE IN A TURBULENT BOUNDARY LAYER OF INCOMPRESSIBLE LIQUID AT $Pr < 1$. E. D. Fedorovich (Polzunov Leningrad Central Turbine Construction Inst.). *Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R.* 2, No. 9, 3-11(1959) Sept. (In Russian)

Results are presented of a theoretical and experimental investigation of heat exchange of a plate in liquid flow where the Prandtl number is much less than 1 (liquid metal). An approximate solution of the problem on the basis of the semiempirical theory of turbulence gives a formula of the type $\bar{Nu} = A Pe^{0.65}$, where $A = 0.38$ to 0.46 , depending on the assumed heat transfer scheme in the turbulent boundary layer. Measurements of the coefficient of heat transfer of a plate in a molten sodium flow was in satisfactory agreement with this calculation. In experiments with eutectic lead-bismuth, coefficients of heat exchange were found to be from 20 to 30% below that calculated. (auth)

4422

THE COOLING PROPERTIES OF A LIQUID. V. A. Krivoukhov, A. I. Belousov, and T. L. Buyanova. *Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R.* 2, No. 5, 15-19(1959) May. (In Russian)

The cooling properties of liquids can be characterized by the rate of cooling of a standard model of an alloy with low heat conductivity; $m = \ln \theta_{init} - \ln \theta_{bin} / \Delta \tau$. To increase the rate of cooling, a liquid must be chosen with maximum heat conductivity and minimum kinematic viscosity. The rate of cooling is a linear function of the flow velocity and increases sharply with a decrease in the temperature of the cooling liquid. (auth)

4423

TEMPERATURE FIELDS IN BODIES OF FINITE DIMENSIONS WITH INTERNAL HEAT EVOLUTION. G. P.

Boikov (Kirov Polytechnic Inst., Tomsk). Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R. 2, No. 5, 36-45(1959) May. (In Russian)

Formulas are given for the approximate calculation of temperature along the axes of symmetry of an infinite bar of elliptical and rectangular section under stationary heat conditions. (auth)

4424

THE NON-STABILIZED FLOW OF A CONDUCTING LIQUID IN THE PRESENCE OF A MAGNETIC FIELD. S. A. Regirer (Northern Section of the Inst. of Permafrost, Vorkuta, USSR). Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R. 2, No. 8, 43-50(1959) Aug. (In Russian)

The steady flow of a viscous, incompressible, electrically conducting fluid between parallel plane surfaces in the presence of a magnetic field was studied by Hartmann. A new solution of this problem is presented using the Laplace transformation for the case of a non-steady flow with homogeneous initial and boundary conditions. The energy equation with dissipation terms is simplified by means of Targ's approximation and solved by the operational method. (auth)

4425

HEAT TRANSFER FROM A NONISOTHERMAL DISK ROTATING IN STILL AIR. J. P. Hartnett (Univ. of Minnesota, Minneapolis). J. Appl. Mechanics 26, 672-3(1959) Dec.

The influence of a variation in the surface temperature on the heat transfer from a disk rotating in still air was studied. The temperature difference between the disk surface and the fluid at rest was allowed to vary as a power function of the radius. The results are given as the ratio of the local Nusselt value for a power-function wall-temperature variation to the isothermal Nusselt value. (C.J.G.)

4426

A SOLUTION OF THE STEADY LINEAR HEAT-FLOW EQUATION WITH HEAT GENERATION AND CONDUCTIVITY ARBITRARY FUNCTIONS OF TEMPERATURE. R. P. Stein (Columbia Univ., New York). J. Appl. Mechanics 26, 685-6(1959) Dec.

4427

HEAT TRANSFER RATES OF AN ARGON PLASMA JET. C. S. Stokes, W. W. Knipe, and L. A. Streng (Temple Univ., Philadelphia). J. Electrochem. Soc. 107, 35-8 (1960) Jan.

Heat flux measurements were made on a small argon plasma jet. Experimental values as high as 4.5 kcal/cm² sec were obtained for the transient-heating rate of a small copper slug. The heat-flux variation with energy supplied and the energy distribution to cathode, anode, and plasma are presented. (auth)

4428

FLOW COASTDOWN IN A LOOP AFTER PUMPING POWER CUTOFF. David Burgreen (Nuclear Development Corp. of America, White Plains, N. Y.). Nuclear Sci. and Eng. 6, 306-12(1959) Oct.

A method is demonstrated whereby the velocity of flow during a coastdown transient in a loop may be analytically determined without the use of pump characteristic curves. The method is approximate, and it appears that the error involved is of the order of magnitude that may be expected in hydraulic calculations. A fair agreement is noted when the results of the analytical method are compared with those obtained by the use of the characteristic curves of

both a single-suction and a double-suction centrifugal pump. A further comparison of the analytical results with collected experimental data for flow coastdown also shows a fairly good agreement. (auth)

Instrumentation

4429 AECU-4514

Duquesne Light Co., Shippingport, Penna. PERIODIC INTERCALIBRATION OF TEMPERATURE SENSING ELEMENTS. SECTION I. FIRST PERFORMANCE. Test Results DL-S-243 (T-641306). First issue, Nov. 9, 1959. 24p. OTS.

Studies were made to determine the direction and magnitude of any drift in the temperature sensing elements and the receiver-indicating units for the primary loop and pressurizer resistance thermometers. Studies were also made to obtain intercalibration data for various temperature sensing elements in the primary coolant system. Determinations of temperature sensing element and instrumentation drifts could not be made due to a lack of comparative data. Five temperature intercalibrations were performed using the calibrating T_c resistance thermometers as a standard. An analysis of all data obtained is presented. (W.L.H.)

4430 ANL-5364

Argonne National Lab., Lemont, Ill. DEVELOPMENT OF REMOTE METALLOGRAPHIC EQUIPMENT FOR THE ANL METALLURGY DIVISION. Final Report [on] Program 6.10.6. S. H. Paine and F. L. Brown. Nov. 1959. 29p. Contract W-31-109-eng-38. OTS.

A summary of the early general development of radio-metallurgy and a short discussion of the special problems that had to be faced at that time are given. A description of the remote metallography installation at the Metallurgy Division of Argonne National Laboratory is given by means of 19 illustrations, together with a discussion of the cave and its major items of equipment. (auth)

4431 HW-37272

General Electric Co. Hanford Atomic Products Operation, Richland, Wash. IN-LINE ALPHA MONITOR PROTOTYPE PERFORMANCE. N. T. Hildreth. Oct. 11, 1955. Decl. Nov. 23, 1959. 31p. Contract [W-31-109-Eng-52]. OTS.

The performance of an in-line alpha monitor for continuously monitoring Pu in Purex Process waste streams is described. The instrument has a lower limit of measurement of 1×10^{-6} grams of Pu per liter and can measure concentrations as high as 7.9×10^{-2} g/liter. (C.J.G.)

4432 KAPL-A-HP-5

Knolls Atomic Power Lab., Schenectady, N. Y. HEALTH PHYSICS MANUAL OF CALIBRATION PROCEDURES FOR PORTABLE AND FIXED SURVEY INSTRUMENTATION. M. R. Kennedy and H. Aceto. Nov. 27, 1959. 76p. Contract W-31-109-Eng-52. OTS.

A summary of the methods used by KAPL personnel to measure the accuracy with which radiation protection instruments respond to radiation standards is presented. Calibration facilities and radiation standards are described and a discussion of instrument operation and theory is included. (J.R.D.)

4433 LA-2361

Los Alamos Scientific Lab., N. Mex. A GRAPHITE-CO₂ IONIZATION CHAMBER INSTRUMENT FOR GAMMA RAY DOSE RATE MEASUREMENTS WITH A

SIX DECADE RANGE, FAST RESPONSE AND REMOTE RECORDING. F. C. V. Worman and Payne S. Harris. Sept. 1959. 22p. Contract W-7405-eng-36. OTS.

A graphite-CO₂ ionization chamber instrument for gamma dose rate measurements is described. The instrument has a dose rate range of six decades, negligible thermal neutron response, rapid recorder response, and facility for remote recording. It is applicable to field reactor studies, such as the Kiwi-A test. (auth)

4434 NAA-SR-4195

Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.

A COIL TYPE LEVEL GAUGE FOR HIGH TEMPERATURE LIQUID METALS. G. E. Turner. Nov. 15, 1959. 25p. Contract AT-11-1-GEN-8. OTS.

An electromagnetic liquid metal level device with an accuracy of ± 1 in., which requires no prior calibration and which will operate continuously at 1000°F, is described. The level gage can be replaced without opening the liquid metal system and is adaptable to automatic operation and recording. (auth)

4435 NP-8100

Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.

QUARTERLY PROGRESS REPORT NO. 55. J. B. Wiesner, G. G. Harvey, and H. J. Zimmermann. Oct. 15, 1959. 184p. Project No. 3-99-00-000. Contract DA-36-039-sc-78108.

A review of the research activities of the laboratory for the three-month period ending August 31, 1959 is given. Progress is indicated in the fields of physical electronics, plasma dynamics, thermoelectric processes and materials, microwave spectroscopy, nuclear magnetic resonance and hyperfine structure, microwave electronics, frequency modulation, statistical communication theory, processing and transmission of information, artificial intelligence, statistical thermodynamics, physical acoustics, speech communication, mechanical translation, and communications biophysics. (For preceding period see NP-7874.) (W.D.M.)

4436 ORNL-2808

Oak Ridge National Lab., Tenn.

BASIC PRINCIPLES OF SCINTILLATION COUNTING. C. C. Harris, D. P. Hamblen, and J. E. Francis. Dec. 10, 1959. 35p. Contract W-7405-eng-26. OTS. Bound with ORINS-30.

The basic principles of scintillation counting are reviewed. The design, performance, and operation of a scintillation spectrometer are described. Emphasis is placed on instruments for medical uses. (C.H.)

4437 RDB(W)-TN-92

Gt. Brit. Windscale Works, Sellafield, Cumb., England. OPERATING EXPERIENCE WITH NO. 1 400 G.P.M. FLAT LINEAR INDUCTION PUMP. T. I. M. Crofts. Sept. 1953. 14p.

Operation of a three phase electro-magnetic pump for 360 hours is reported. Experience gained in this operation with NaK was used when modifications to a second pump rig was made. The effectiveness of these modifications is shown by completion of 1,000 hours operation on the second rig. (J.R.D.)

4438 SCDC-727

Sandia Corp., Albuquerque, N. Mex.

AN APPLICATION OF CORRELATION DETECTION TO ELECTRONIC TRAJECTORY MEASUREMENT. Bruce J. Weston. [Apr. 18, 1958]. 9p. OTS.

A receiver designed for use in ROMOTAR electronic trajectory measurement system is described. Theory of operation is also outlined and various applications are given. Test results show an improvement of 5 to 8 db in ROMOTAR correlation receivers over other receivers tested. (J.R.D.)

4439 SCR-128

Sandia Corp., Albuquerque, N. Mex.

A TRANSISTORIZED SIX-CHANNEL AIRBORNE STRAIN GAGE CALIBRATOR AND EXCITATION UNIT. R. H. Gablehouse and C. E. Erickson. Nov. 1959. 20p. OTS.

The device consists of two subassemblies: the Excitation Unit and the Calibrator Unit. The Excitation Unit provides six independent sources of regulated d-c power from a single source of 28 volts d-c. The capacity of each source is nominally 1 watt providing either 10.5 or 2v.5 volts excitation for bonded or unbonded strain gages. The Excitation Unit comprises a transistor series voltage regulator which controls the input to a transistor magnetic flip-flop power supply. The Calibrator Unit consists of a Ledex switch which connects strain-simulating resistors across the appropriate arms of the strain gage bridge. The values of these resistors are calculated to simulate precise values of strain or acceleration and provide an accurate scale factor on the final telemetered record. The Ledex rotary switch has three double decks for calibrating six channels of strain and one deck for voltage increments from zero to plus three volts for calibration of voltage controlled sub-carrier oscillators. (auth)

4440 UCRL-8857

California, Univ., Berkeley. Lawrence Radiation Lab. LIQUID-HYDROGEN TARGET. Duane D. Newhart, Victor Perez-Mendez, and William L. Pope. Aug. 18, 1959. 13p. Contract W-7405-eng-48. OTS.

A 48-in.-long liquid-hydrogen target is described. The operating characteristics of the target and its safety features which follow the regulations laid down by the Hydrogen Safety Committee of the Lawrence Radiation Laboratory are stressed. (auth)

4441 AEC-tr-3912

FAST NEUTRON SCINTILLATION SPECTROMETER.

Yu. A. Egorov. Translated by Lydia Venters (Argonne National Lab.) from Priboiy 1 Tekh. Ekspt., No. 3, 21-6 (1958). 12p. JCL or LC.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 1318.

4442

THE USE OF CADMIUM SULFIDE CRYSTALS FOR THE MEASUREMENT OF ROENTGEN RADIATION. Elmer G. St. John and Earl Fish (Binghamton City Hospital, N. Y.). Am. J. Roentgenol., Radium Therapy Nuclear Med. **83**, 156-62(1960) Jan.

A small, stable, probe-like device for the detection and measurement of roentgen radiation has been successfully developed, utilizing a very small cadmium sulfide crystal in its tip. This method is characterized by reliability, low impedance circuitry, small size, low cost, low power consumption and extreme ruggedness. The construction of flexible probes should make this method well suited for intra-body medical probes. (auth)

4443

A DIFFRACTOMETER FOR ACCURATE X-RAY INTENSITY MEASUREMENTS. U. Korhonen and S. Vihinen. Ann. Acad. Sci. Fennicae Ser. A VI, No. 10, 1-12(1958).

An automatically recording x-ray diffractometer is described. The intensities of the diffraction lines are meas-

ured by means of a photomultiplier tube feeding a bridge amplifier and finally an automatic recorder. The diffractometer is of the Bragg-Brentano type in which the specimen, the detector (photomultiplier), and the paper chart of the recorder move synchronically. The accuracy, reliability, and the resolving power of the instrument are discussed. The accuracy proved to be 0.1 to 0.2%. (auth)

4444

AN ELECTROSTATIC INVERTER. Teuvo Kohonen. *Ann. Acad. Sci. Fennicae Ser. A VI*, No. 32, 1-11(1959).

By using revolving contactors, an upper signal frequency limit of about 200 cps was achieved on the device. No drift was found in the output. Wiring schemes are given to perform such operations as inversion of sign, addition, subtraction, and voltage multiplication. (C.J.G.)

4445

SELECTING TRANSISTORS FOR RADIATION ENVIRONMENTS. John R. Bilinski and Richard Merrill (General Electric Co., Ithaca, N. Y.). *Electronics* 32, No. 52, 38-40(1959) Dec. 25.

Nomographs are presented which can be used to determine the percentage change in grounded emitter current gain of germanium and silicon npn and pnp transistors neutron flux. Equations are given to calculate the effect of radiation on the volume recombination term and the change in transistor current gain as a function of neutron flux. (C.J.G.)

4446

FAULT ANALYSIS OF NUCLEONIC EQUIPMENT. R. B. Shields (Chalk River Atomic Plant, Ont.). *Electronics and Commun.* 6, No. 2, 24-6(1958) Feb.

A system for continuous tabulation of faults in electronic equipment was set up at the Chalk River Atomic Plant in Jan. 1956 using punched cards. The system and its many uses are described and some of the difficulties are pointed out. (W.D.M.)

4447

THE DETERMINATION OF THE COEFFICIENT OF UTILIZATION OF RADIOACTIVE RADIATION FOR FLAT TYPE IONIZATION CHAMBERS. A. N. Slatinski (Central Scientific Research Inst. of the Cotton Industry, Moscow). *Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R.* 2, No. 6, 80-83(1959) June. (In Russian)

The value of the radiation utilization coefficient of flat type ionization chambers depends on the distance between the collecting electrodes in the chamber and on the distance from the input opening of the chamber to the surface of the radioactive source, and can be determined by the

equation: $\alpha = 0.25 \left[1 + \frac{1}{\pi} \arctg \frac{M(M^2 - 8N^2)}{N(5M^2 - 4N^2)} \right]$, $\alpha = \frac{0.25}{\pi} \arctg \frac{M(M^2 - 8N^2)}{N(5M^2 - 4N^2)}$. If there is a blind between the

port of the ionization chamber and the surface of the radiation source, the radiation utilization coefficient depends on the distance from the input port of the chamber to the surface of the radiation source, on the distance between the source and the blind covering it, and on the size of the opening in the source covered by the blind. The value of the radiation utilization coefficient can be determined by

the following equation: $\alpha = \frac{0.25}{\pi} \arctg \frac{l(N + \delta)}{N\delta - l^2}$. (auth)

4448

THE EFFECT OF PLASTIC DEFORMATION ON THE HALL CONSTANT IN BISMUTH. V. G. Sidiyakin and V. N. Danilov (Polytechnic Inst., Kiev). *Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R.* 2, No. 6, 84-7(1959) June. (In Russian)

The connection between the Hall constant and the plastic deformation of bismuth is investigated. Experiments showed that the greatest change in the Hall constant depending upon the degree of plastic deformation occurs when relative deformation is 43%. The increase in the ratio R_0/R_D (where R_0 is the Hall constant of a nondeformed sample, and R_D is the Hall constant of a deformed sample) to 43% can be explained by the change of the electronic density distribution and of the spectrum of collectivised electrons. A further increase in this ratio causes the sample to break. Taking into account the special position of bismuth, no generalization was made for other metals. (auth)

4449

SURFACE-TEMPERATURE MEASUREMENT OF CURRENT-CARRYING OBJECTS. Richard Dutton and Eugene C. Lee (ASTRO, Van Nuys, Calif.). *ISA Journal* 6, No. 12, 49-51(1959) Dec.

A description of a three-wire pyrometer circuit for measuring surface-temperatures of current-carrying objects is given. The circuit incorporates a voltage-dividing potentiometer in each of two similar (chromel) thermocouple circuits. An adjustable compensator eliminates error due to inaccurate placement of the thermocouple wires on the surface. Temperatures up to 1800°F were measured on tubes enclosed in a cylindrical shield with quartz windows. (C.J.G.)

4450

IMPROVED MICROBEAM BACK-REFLEXION X-RAY CAMERA WITH ARRANGEMENT FOR IRRADIATING A PRE-SELECTED AREA. H. M. Otte and R. W. Cahn (Univ. of Birmingham, Eng.). *J. Sci. Instr.* 36, 463-5(1959) Nov.

An improved camera is described for use in conjunction with a microfocus x-ray tube. It has the advantages of being more rapid and precise in setting and of enabling much shorter exposure times to be used for x-ray beams of 10 to 50 μ in diameter. (auth)

4451

DIRECT STRESS MACHINE FOR COMBINED FATIGUE AND CREEP TESTING. A. H. Meleka (British Iron and Steel Assn., London). *J. Sci. Instr.* 36, 468-71(1959) Nov.

The modification of a creep testing machine into a combined fatigue and creep testing device is described. Creep stresses can be applied up to 2000 kg cm⁻² and fatigue stress amplitudes up to 500 kg cm⁻², the fatigue frequency ranging between 200 and 3000 cps. The performance of the machine is illustrated by superimposing fatigue stress on a copper specimen under a static creep stress of 625 kg cm⁻² and 450°C. Advantages of the modified machine are comparatively low cost and simplicity of operation. (C.J.G.)

4452

AN APPARATUS FOR MEASURING RESISTIVITY AT ROOM TEMPERATURE AND HIGH TEMPERATURE. J. Bellot, N. Sacovy, and J.-M. Henry (Commissariat à l'Énergie Atomique, Paris). *Métaux(Corrosion-Inds.)* 33, 243-52(1958) June. (In French)

Apparatus for measurement of resistivity from room temperature up to 1000°C is described. Transformation kinetics of some U-Mo alloys were studied at room temperature and an interpretation of the mechanism of the transformations from sursaturated phase γ to equilibrium phases is given. (auth)

4453

BUBBLE COUNTING ON LOW-ENERGY PARTICLE TRACKS. I. R. Birss (The University, Glasgow). *Nature* 184, Suppl. No. 19, 1474(1959) Nov. 7.

The possibility was investigated of distinguishing between the tracks of mesons and protons in bubble chambers by measurements of linear bubble density. From the results it was concluded that bubble counting provides a satisfactory method for the separate identification of protons and mesons. (C.H.)

4454

ELECTRON MICROSCOPY OF AUTORADIOGRAPHED RADIOACTIVE PARTICLES. L. A. George, II, and G. S. Vogt (General Electric Co, Richland, Wash.). *Nature* 184, Suppl. No. 19, 1474-5(1959) Nov. 7.

A modification is described in the technique of electron microscopy and autoradiography for the identification of radioactive particles collected on millipore filters. This work was in support of an investigation into the effects of the inhalation of radioactive particles. (C.H.)

4455

ESTIMATION OF TRITIUM IN THE GAS PHASE. Elwira Herczynska (Instytut Badań Jądrowych PAN, Warsaw). *Nukleonika* 4, 381-8(1959). (In Polish)

The method of counting tritium in the gas phase is given with a detailed description of work on H^3 counting as tritio-methane in G-M counters with internal filling. Tritio-methane was prepared by reaction of tritiated water with aluminum carbide, purified before use by heating with Na in a vacuum and in air. Both internal cathode (tin chloride) and external cathode (aquadag) counters were used. The plateau length for the external cathode counter was 400 to 1000 v. A plateau slope of less than 3%/100 v was determined. (auth)

4456

ELECTRONIC COUNTER TYPE PD-56. Aleksander Kurczewski (Zakłady Wyróbów Elektrotechnicznych "Eltra," Bydgoszcz, Poland). *Nukleonika* 4, 451-3(1959). (In Polish)

Descriptions are given of a type PD-56 scaler with 2×10^5 cps counter rate. Specifications are included. (R.V.J.)

4457

PORTABLE G-M MONITOR TYPE ML-56. Aleksander Kurczewski (Zakłady Wyróbów Elektrotechnicznych "Eltra," Bydgoszcz, Poland). *Nukleonika* 4, 453-5(1959). (In Polish)

The design, operation, and specifications are presented for survey meter ML-56 capable of monitoring β and γ radiation in ranges 0.03 to 0.4 and 0.3 to 20.0 mr/h. (R.V.J.)

4458

PORTABLE G-M MONITOR TYPE ML-57. Aleksander Kurczewski (Zakłady Wyróbów Elektrotechnicznych "Eltra," Bydgoszcz, Poland). *Nukleonika* 4, 456-8 (1959). (In Polish)

The design is presented of survey meter ML-57 for monitoring γ rays in mining explorations. Specifications and operation of the meter are included. (R.V.J.)

4459

DIRECTIONAL PROPERTIES OF AN EXTENSIVE AIR SHOWER ARRAY. C. B. A. McCusker, D. E. Page, and R. J. Reid (Dublin Inst. for Advanced Studies). *Phys. Rev.* 116, 181-2(1959) Oct. 1.

The directional properties of an extensive air shower array consisting of three Geiger-Mueller counter telescopes were examined. It is shown that the directional properties of this array show no great improvement over more conventional arrangements. Possible ways of improving the performance of the device are suggested. (auth)

4460

A PRECISION MOUNTING FOR BENDING THE ANALYZING CRYSTAL IN X-RAY- AND γ -SPECTROMETERS. H. De Lang (Rijks-Universiteit, Groningen, Netherlands). *Physica* 26, 945-53(1959) Oct. (In English)

The aberrations of a bent crystal are briefly discussed. A precision mounting is described in which the analyzing crystal is bent elastically. The asymmetrical broadening of the spectral lines is corrected by de Wolffs' method viz. giving the curvature a constant gradient in the plane of incidence by exerting unequal moments on the ends of the crystal. Aberrations due to secondary curvature are avoided by giving the crystal a toroidal shape. An optical inspection method to test the bending is described. (auth)

4461

COUNTING EFFICIENCY OF Co^{56} , Co^{58} AND Co^{60} WITH 2 COUNTERS AND 3 COUNTING TECHNIQUES. Leon Ellenbogen (American Cyanamid Co., Pearl River, N. Y.). *Proc. Soc. Exptl. Biol. Med.* 102, 667-9(1959) Dec.

A NaI well scintillation counter and a beaker adapted to fit on and around the NaI well as well as a plastic well scintillation counter, were used to compare efficiency of Co^{56} , Co^{58} , and Co^{60} as a function of volume. The plastic well counter is as efficient for Co^{56} as the NaI well and more efficient for Co^{58} and Co^{60} than the NaI well for small volumes (1 to 4 ml). For intermediate volumes (4 to 250 ml) the plastic well is the more efficient and the efficiency is almost independent of sample volume from 10 to 100 ml. Mice or small rats up to about 75 g and tissue samples can be counted in the plastic well without correction for geometry. The efficiency of 250 ml in the plastic scintillation counter is 22.6, 11.6, and 18.3% for Co^{56} , Co^{58} , and Co^{60} , respectively and 7.8, 3.5, and 3.8%, respectively for 1000 ml using the beaker on the NaI well. The choice of instrument for counting large volumes is discussed. (auth)

4462

DESIGN OF FREE-AIR IONIZATION CHAMBERS FOR THE SOFT X-RAY REGION (20-100 kv). Victor H. Ritz (National Bureau of Standards, Washington, D. C.). *Radiology* 73, 911-22(1959) Dec.

Criteria are presented for the design of free-air ionization chambers for the soft x-ray region of 20 to 100 kv. (C.H.)

4463

USE OF MAGNETIC TAPE FOR RECORDING RADIOACTIVITY. Solomon N. Albert, H. N. Eccleston, Jr., T. Fujita, Charles H. Hunter, and Chalom A. Albert (District of Columbia General Hospital, Washington, D. C.). *Radiology* 73, 923-6(1959) Dec.

A simple adaptation of magnetic tape recorders to rate meters or scalars has been devised. This can be used for registering impulses from detectors in order to record and measure radioactivity. (auth)

4464

THE G. B. M. GAMMAMETER. J. Berb  zier, R. B  rtolli, and M. Lesueur (Commissariat    l'  nergie Atomique, Paris). *Rev. g  n. elec.* 67, 407-14(1958) Aug. (In French)

The "Gammameter," an apparatus used in uranium prospecting, is described. Based on the ionizing action of gamma-rays, the unit comprises an integrator associated with a GM counter. The conditions governing the use of the apparatus are given, and it is in detail, and its general characteristics are stated. A study was made of the operation of the gammameter and its instrumentation, including the job of the integrator and its succession of functions organized to obtain maximum sensitivity. The G.M.M. meter is briefly dealt with: its operating principles and general

assembly are much the same as the G.B.M. model, apart from the counter, which is incorporated in a sonde for radiosounding. (auth)

4465

CONCERNING A CALORIMETRIC METHOD OF MEASUREMENT OF INTENSITY OF SOFT X-RAYS. Helmut Pauly (Max-Planck-Institut für Biophysik, Frankfurt am Main). *Strahlentherapie* 110, 462-76(1959) Nov. (In German)

A calorimeter was described and the intensity of x rays of a 45 kv soft ray tube with beryllium window was measured. The calorimeter is suitable for the determination of radiation intensities between 10^{-2} and 10^{-6} [cal · cm⁻² · sec⁻¹]. In addition the energy absorption of aluminum, copper, lead, and plexiglas in relation to the thickness of the medium was determined and the dose rate was reported in rad. (auth)

4466

MILLIMICROSECOND PULSE TECHNIQUES. SECOND EDITION. I. A. D. Lewis and F. H. Wells. International Series of Monographs on Electronics and Instrumentation. Volume 5. New York, Pergamon Press, 1959. 434p. \$8.50.

Electrical devices concerned with the handling of information in the millimicrosecond range (10^{-6} to 10^{-10} sec) are discussed. The theory, design, and application of various types of transmission lines, transformers, pulse generators, amplifiers, and cathode ray oscilloscopes are presented. The application of these circuits and other more specialized circuits to measurement problems encountered in nuclear physics is discussed. (C.J.G.)

4467

IMPROVEMENTS IN OR RELATING TO GAUGES. Eric Brayton Bell and Brian Jerrold Jordan (to Isotope Developments, Ltd.). British Patent 818,105. Aug. 12, 1959.

A radiometric gage for measuring eccentricity or thickness of wires, tubes, pipes, and insulation is described. For thickness measurements the amount of radiation absorption is used. For eccentricity measurements a waveform for zero eccentricity is used as a standard. (T.R.H.)

4468

IMPROVEMENTS RELATING TO IONIZATION CHAMBERS. (to General Electric Co.). British Patent 822,560. Oct. 28, 1959.

An ionization chamber design is offered which gives a high output current at an impedance of about 10^7 ohms. This is accomplished by applying a potential difference between anode and cathode to cause space-charge current flow in the absence of radiation but a much larger current during irradiation. The current drawn by virtue of the emitting cathode is 10^4 times that of ordinary chambers. (T.R.H.)

4469

IMPROVEMENTS RELATING TO ION SOURCES. (to Compagnie Generale de Telegraphie Sans Fil). British Patent 824,728. Dec. 2, 1959.

An ion source design similar to the Dempster-Nier type is presented. A laminar electron beam is focused on a gas-filled space between electrodes to produce ions which are moved by crossed electric and magnetic fields to apertures in a collector. A supplementary electrode in the space focuses electrons and ions. The shape and arrangement of electrodes are described in detail. The design offers lower pumping power. (T.R.H.)

4470

IMPROVEMENTS IN OR RELATING TO PNEUMATIC LINEAR DIMENSION GAUGES. Frank Dennis Harden

(to United Kingdom Atomic Energy Authority). British Patent 824,847. Dec. 9, 1959.

A wide-range pneumatic linear-dimension gage is described. To vary the range, a lever arrangement is provided which extends or reduces the movement of the diaphragm stack or bellows. (T.R.H.)

Materials Testing

4471

SSC-125
Lloyd's Register of Shipping, London.
SOME OBSERVATIONS ON THE BRITTLE FRACTURE PROBLEM. G. M. Boyd. July 31, 1959. 22p.
The modes and kinds of brittle fracture are reviewed. The initiation of unstable fracturing is discussed. Methods of measuring brittle fracture are reviewed. (W.L.H.)

GEOLOGY, MINERALOGY, AND METEOROLOGY

4472

THE STRUCTURE OF SOME HYDRATED URANIUM COMPOUNDS. J. Toussaint and H. Brasseur (Université de Liège). *Bull. classe sci., Akad. roy. Belg.* (5), 45, 501-6 (1959). (In French)

In the uranium minerals studied (billietite, becquerelite, schoepite, wolsendorfite, fourmarierite, and vandendriesscheite) the uranium atoms are placed at the nodes of a simple pseudohexagonal lattice whose cell varies only slightly from one mineral to the other. The average dimensions are 4.1 Å for the side of the hexagon and 7.4 Å for the prism height. It is deduced that the structure of these compounds is based on the existence of non-defined plane layers with the composition $\text{UO}_2(\text{O},\text{OH})_2$. (tr-auth)

4473

CUPROSKLODOWSKITE. J. Mélon and J. Dejacé. *Bull. classe sci., Akad. roy. Belg.* (5), 45, 507-15(1959). (In French)

Cuprosklodowskite, with the composition $\text{CuO} \cdot 2\text{UO}_3 \cdot 2\text{SiO}_2 \cdot 6\text{H}_2\text{O}$, is triclinic with the parameters $a = 7.04$, $b = 9.18$, and $c = 6.66$ Å and $\alpha = 109^\circ 14'$, $\beta = 90^\circ 0'$, and $\gamma = 108^\circ 22'$. The aciculated crystals are elongated on the a [100] axis and have the faces {001}, {011}, {010}, $\{\bar{1}11\}$, {110}, $\{1\bar{2}0\}$, and $\{2\bar{1}0\}$. The macles are associated either with the axis of the [100] macle and (010) boundary plane or with the $\{2\bar{1}0\}$, macle plane. The optical orientation, the indices of refraction, and the angle of the optical axis are determined exactly. (tr-auth)

4474

THE GEOCHEMISTRY OF RHENIUM, WITH SPECIAL REFERENCE TO ITS OCCURRENCE IN MOLYBDENITE. Michael Fleischer (U. S. Geological Survey, Washington, D. C.). *Econ. Geol.* 54, 1406-13(1959) Dec.

Little has been added to knowledge of the geochemistry of rhenium since the work of Noddack and Noddack in 1931, except that many determinations have been published of the rhenium content of molybdenite, the only present source. These determinations, 150 in all, have been assembled. The rhenium content of molybdenite ranges from none to 3,250 ppm Re, and varies widely, even in samples from a single deposit. No generalizations are yet possible as to correlations of rhenium content with geological conditions of formation. Other possible sources of rhenium are considered briefly. (auth)

4475

THE DEVELOPMENT OF NUCLEAR GEOPHYSICS. Kazimierz

mierz Przewłocki (Akademia Górniczo-Hutnicza, Kraków). *Nukleonika* 4, 417-39(1959). (In Polish)

A review of the development of nuclear geophysics in the field of prospecting for metals and nuclear raw-materials is given. The methods discussed include γ -ray measurements from (n, γ) reactions and γ -spectrometry in bore-holes. The possibility of constructing and applying a special neutron source which could be used in bore holes is discussed. (C.J.G.)

4476

CONTRIBUTION TO THE KNOWLEDGE OF THE URANIUM ORES OF MONTE BESIMAUDA (PIEDMONT ALPS).

Felice Ippolito and Pasquale Nicotera. *Rend. soc. mineral. ital.* 9. 9p.(1953). (In Italian)

The results of preliminary studies on the uranium ores of Monte Besimaua are reported. The absence of filon or dike formations in any uranium mineralizations was established. Strong radioactivity was detected in the series of rocks of various types which constitute the metamorphic complex, but uranium was not distinguishable microscopically. Since the schist is parallel to the original stratigraphy of the various lithologic types, a mineralization of the "horizon" of the original complex is indicated. The rocks of this "horizon" are briefly described. (J.S.R.)

4477

FINE SAND AS A BACK FILLING. A. Ginocchio (Commissariat à l'Énergie Atomique, Paris). *Rev. ind. minérale* 40, No. 6, 8p. (1958) June. (In French)

Back filling requirements in the working of many veins induced us to examine, in parallel with systems utilizing materials from quarries and diggings, other systems for the use of processing waste as a back filling. Our processing plants do not produce much calibrated grain waste, which is about the most easily used back filling, so we turned our attention to the utilization possibilities of the waste or mullock. We were aware of the interesting results obtained in some workings by the use of processing waste after it had been cycloned. A report is given on the data on the process, and the results of preliminary tests carried out at laboratories and pilot plants. (auth)

4478

URANIUM IN THE ROCKS OF THE PALEOZOIC EFFUSIVE FORMATION OF TRENTINO-ALTO ADIGE. Nara Coradossi (The Università, Florence). *Ricerca sci.* 29, 2032-48(1959) Oct. (In Italian)

The distribution of the uranium in rocks of the paleozoic effusive series of Trentino-Alto Adige was studied. The average amount of HNO_3 soluble uranium is 0.8 ppm U_3O_8 ; the total uranium in the ignimbritic portion of the series is 1.4 ppm U_3O_8 . The uranium determinations were accomplished by means of fluorimetric methods. The statistical distribution of uranium in the series is discussed as well as the relations between the uranium content in the upper effusive rocks (ignimbritic series) and the possibility of mineralization in either the series itself or the rocks which are formed by its alteration. (auth)

4479

THE UTILIZATION OF RADIOACTIVITY FOR THE BUCKLING OF ORES AND ASSESSMENT OF URANIUM DEPOSITS. G. H. Carrat and J. Berbezier (Commissariat à l'Énergie Atomique, Paris). *Sci. Terre(Ann. école natl. supérieure géol. appl. prospection minière univ. Nancy)* 4, 227-38(1956). (In French)

The radioelectrics used for the buckling of ores at mine outlets by means of G-M counters plus amplifiers and integrators, known as the "Baraque-Tunnel" method are described. The trucks pass under activity detectors which

measure the radiation intensity, and the measurement is transposed into an assessment of the uranium content by ancillary equipment. A discussion is given of the measurement itself, with a description, its practical application, and the electronics used, with their calibration, plus finally the numerous difficulties encountered in application of the process. (auth)

4480

STRATIGRAPHY OF TRIASSIC AND ASSOCIATED FORMATIONS IN PART OF THE COLORADO PLATEAU REGION. John H. Stewart, George A. Williams, Howard F. Albee, and Omer B. Raup. *SEDIMENTARY PETROLOGY*. Robert A. Cadigan. *U. S. Geol. Survey Bull.* 1046-Q, 1959. 96p., 1 illus. \$0.65(GPO).

Stratigraphic studies of the Triassic and associated formations were made in southeastern Utah and adjoining parts of Colorado and Arizona. Five principal lines of investigation were followed: regional stratigraphy, sedimentary petrology, pebble studies, sedimentary-structure studies, and lithofacies studies. The formations studied are the Cutler formation, Coconino sandstone, and Kaibab limestone of Permian age; the Moenkopi formation, Chinle formation, and Wingate sandstone of Triassic age; the Kayenta formation of Jurassic(?) age; and the Navajo sandstone of Jurassic and Jurassic(?) age. Most of the uranium deposits in the Triassic rocks are in the Shinarump, Monitor Butte, and Moss Back members of the Chinle formation, and in the base of undifferentiated Chinle. The deposits are generally near the base of the Chinle, regardless of which unit of the formation lies in that position. The deposits lie in broad northwestward-trending belts near the north limit of the respective units. Many determinations have been made of the types of clay minerals in the sandstones in the Triassic and associated formations. Evidence supports the hypothesis that much of the hydromica in the Chinle is the result of alteration of montmorillonite in the presence of soluble potassium salts. Thin-section studies of ore-bearing sandstone and barren sandstone in the Shinarump and Moss Back members of the Chinle formation suggest that uranium ore occurs predominantly in sandstone that contains 20% or more kaolin, and that strata containing 15 to 35% kaolin should be considered more favorable for the occurrence of uranium than strata containing less than 15% kaolin. (auth)

4481

LEAD-ALPHA AGE DETERMINATIONS OF ACCESSORY MINERALS OF IGNEOUS ROCKS (1953-1957). Howard W. Jaffe, David Gottfried, Claude L. Waring, and Helen W. Worthing. *U. S. Geol. Survey Bull.* 1097-B. 1959. 87p. \$0.30(GPO).

The U. S. Geological Survey completed lead-alpha age determinations of accessory minerals from about 400 rocks between July 1953 and January 1957. All the ages and the experimental data, equations, and constants from which they were calculated are given in tabular form. A citation of the most probable geologic age of each rock is included for comparison with the measured age. The tabulation is followed by a geographic index of sample localities (auth)

HEALTH AND SAFETY INCLUDING DOSIMETRY

4482 AERE-R-2924

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

THE MEASUREMENT OF NEUTRON DOSE. A. B. Clare. July 1959. 33p. BIS.

The physical (as opposed to the biological) data which are used to derive the maximum permissible neutron flux are summarized. Problems which arise in field instrumentation designed to measure the neutron dose are surveyed. Methods for measuring dose include energy absorption in tissue equivalent chambers, flux detection with sensitivity inversely proportional to maximum permissible flux and threshold detection. In addition to continuous irradiation by neutron flux the special problems associated with particle accelerators and criticality accidents are considered. (auth)

4483 KAPL-A-RP-1

Knolls Atomic Power Lab., Schenectady, N. Y. S3G RADIATION PROTECTION MANUAL. B. F. Knapp and W. H. Truran, eds. Oct. 15, 1959. 266p. Contract W-31-109-Eng-52. OTS.

A manual is presented which was prepared to serve as a training and operating guide for KAPL and USN personnel who perform radiation protection functions at the S3G facility. The S3G power plant, which consists of one reactor and one set of propulsion equipment, is used to evaluate the performance of the SSR(N)586 power plant in operation. The radiological hazards involved are summarized and instructions are provided for the operation of radiation protection instruments. Radiation exposure control limits, safe discharge limits for contaminated air and water, and methods of controlling and minimizing radiation hazards are included. (W.D.M.)

4484 IGIS-46(RD/R)

THE IMPORTANCE OF DETAILED EXAMINATIONS OF EMPLOYEES WORKING WITH MERCURY. PART I. PERIODICAL EXAMINATIONS OF EMPLOYEES SUBJECT TO KNOWN EXPOSURE (ESTIMATION OF THE MERCURY LEVEL IN THE URINE). J. Totusek. Translated by R. G. Evan (U.K.A.E.A., Risley) from *Pracovní lékařství* 6, 99-101(1954). 7p.

The results of the examinations of 93 persons from 6 different mercury processing plants, where the mercury concentration in the air was measured repeatedly are reported. In the tables, the author compares the objective diagnoses, together with the neurological findings and the Hg estimation in the urine, with the results of the periodical Hg measurement in the air. Houstková's method for the determination of mercury in biological materials is discussed. According to the author, collective findings of up to 200 gammas/liter urine indicate normal exposure, for up to 400 gammas/liter urine there is an expression of the possibility of poisoning, while values above 400 gammas/liter urine represent a diagnostic index, whereby the possibility of lower values does not exclude the possibility of poisoning. This fact is explained, in accordance with the findings of other investigators, by the irregular urine excretion, and by the individual mercury retention faculty of the organism. Finally, it is recommended that the limit of 0.1 gamma/liter air should be rigorously enforced, while there is even a possibility that this value might, after further study of the results, have to be reduced to 0.01 gamma/liter air.

4485

PLANNING FOR A RADIATION ACCIDENT. Eugene L. Saenger (Univ. of Cincinnati). *Am. Ind. Hyg. Assoc. J.* 20, 482-7(1959) Dec.

With careful organization and training of both plant and community health facilities the confusion of radiation acci-

dents can be significantly decreased. Rational approaches to potential radiation accidents are described and discussed. (C.H.)

ISOTOPE SEPARATION

4486 AERE-R-3043

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

THE ELECTROMAGNETIC SEPARATION OF PLUTONIUM ISOTOPES: OPERATIONAL EXPERIENCE IN 1957. J. H. Freeman, K. J. Hill, and M. L. Smith. Aug. 1959. 61p. BIS

A brief description of the 90° sector electromagnetic separator, HERMES, includes the actual machine, source unit, collectors and the associated electrical and other services. Separation experience up to February 1958 is given in considerable detail, first with preliminary runs on lead, cerium, thorium and uranium, and then, over a period of 9 months, with plutonium containing 6% Pu²⁴⁰. Experiments on a range of pocket designs are described and resolution, outputs, efficiencies, etc. discussed. An analysis of machine and service failures is included, and Appendix VII sets out the operational checks and procedures, and provides an indication of the operator training problems involved in the project. The report concludes with a brief discussion on the relative merits of sealed room and other possible modes of working on projects of this type. A list of the plutonium isotopic samples provided for various applications is given. (auth)

4487

WORKING CHARACTERISTICS OF RECTIFICATION AND OF TWO-TEMPERATURE DEUTERIUM EXCHANGE PROCESS. Manfred Dietze and Siegfried Pilz. *Chem. Tech. (Berlin)* 11, 544-6(1959) Oct. (In German)

Equations are developed for the dual-temperature deuterium-exchange process using balance-loops to represent the process. (T.R.H.)

4488

METHOD OF AND APPARATUS FOR THE SEPARATION OF GASES. (to Aktiebolaget Atomenergi). British Patent 824,594. Dec. 2, 1959.

A gaseous diffusion separation using a barrier of Al₂O₃ is described. The barrier is formed by anodic oxidation of an 0.02 to 0.05 mm Al foil in 5% H₂SO₄. Electrolysis at 30 v (alternating) and a current density of 5 to 7 amp/dm² gave membranes with a permeability of 0.01 to 0.1 cm³/cm² sec atm. Pore diameter averaged 2 × 10⁻⁵ mm. Heat treatment at 500 to 550°C for 2 hr improved permeability. (T.R.H.)

4489

PROCESS FOR OBTAINING WATER OR HYDROGEN WITH AN INCREASED DEUTERIUM CONTENT. Erwin Willy Albert Becker. British Patent 824,820. Dec. 2, 1959.

A previously described process for enriching D in H₂O or H₂ is modified. In the previous process, H₂ and water with colloiddally suspended catalyst are cycled in countercurrent flow through a hot and a cold column. In the hot column NH₃ is formed from N₂ impurity in the H₂ and damages the catalyst. A third or transfer column can be added to overcome this difficulty. The transfer column, operated at about 45°C, has hydrogen in a separate cycle countercurrently flowing through it with water and catalyst from the hot column. Pure H₂ is thus cycled through the

hot and cold columns and N_2 is removed by the separate hydrogen cycle provided for the transfer column. (T.R.H.)

4490

HEAVY WATER CONCENTRATION BY FRACTIONAL DISTILLATION. (to Shawinigan Chemicals, Ltd.). British Patent 824,954. Dec. 9, 1959.

A combined D concentration and power-production process is described. Steam from a boiler is cycled through a high-pressure turbine and a fractionating column countercurrent to condensate from a second low-pressure turbine. Natural water is fed to the low-pressure end of the column and returned to the boiler from the other end. Low-pressure steam from the column drives the second turbine. In an alternate arrangement the two turbines are connected in series and low-pressure steam from the column goes directly to the condenser. In both arrangements water enriched in D is drawn from the boiler and depleted water is drawn from the low-pressure cycle. (T.R.H.)

MATHEMATICS AND COMPUTERS

4491

ANL-5990(Rev.)

Argonne National Lab., Lemont, Ill.
VARIABLE METRIC METHOD FOR MINIMIZATION.
William C. Davidon. Nov. 1959. 21p. Contract W-31-109-eng-38. OTS.

A method for determining numerically local minima of differentiable functions of several variables is presented. In the process of locating each minimum, a matrix which characterizes the behavior of the function about the minimum is determined. For a region in which the function depends quadratically on the variables, no more than N iterations are required, where N is the number of variables. By suitable choice of starting values and without modification of the procedure, linear constraints can be imposed upon the variables. (auth)

4492

ANL-6051

Argonne National Lab., Lemont, Ill.
ANALYTIC SOLUTION OF THE STEADY-STATE WAVE EQUATION IN THREE DIMENSIONS AND IN IRREGULARLY SHAPED DOMAINS WITH AN APPLICATION TO A REACTOR WITH PARTIALLY INSERTED CONTROL RODS.
E. J. Betinis. Sept. 1959. 102p. Contract W-31-109-eng-38. OTS.

A method of successive approximations was developed for solving the steady-state wave equation, $(\nabla^2 + \Lambda)\phi = 0$, in an arbitrarily shaped n -dimensional domain with ϕ subject to homogeneous boundary conditions. The Helmholtz operator $\nabla^2 + \Lambda$ is considered and extensions to more general operators are treated. The technique was applied in solving the one-group diffusion equation for a bare, homogeneous cylindrical thermal reactor with many partially or fully inserted control rods. Formulas were derived for the solution to the equation for irregularly shaped rectangular domains. (W.D.M.)

4493

DTMB-1346

David Taylor Model Basin. Applied Mathematics Lab., Carderock, Md.
LECTURES ON APPLIED MATHEMATICS: THE LAPLACE TRANSFORMATION. Francis D. Murnaghan. June 1959. 171p.

The lectures on applied mathematics are devoted to the Laplace Transformation and its application to linear ordinary differential equations with variable coefficients, to linear partial differential equations, with two independent variables and constant coefficients, and to the determina-

tion of asymptotic series. The treatment of the Laplace Transformation is based on the Fourier Integral Theorem and the ordinary differential equations selected for detailed treatment are those of Laguerre and Bessel. The partial differential equation governing the motion of a tightly stretched vibrating string and a generalization of this equation are fully treated. Asymptotic series for the in-

tegral $\int_p^\infty \exp(-z^2)dz$ and for modified Bessel function

$I_n(p)$, $|\arg p| < \frac{\pi}{2}$, are obtained by means of the Laplace

Transformation and, finally, asymptotic series useful in the calculation of the ordinary Bessel functions $J_n(t)$ are treated. Care has been taken to make the treatment self-contained and details of the proofs of the basic mathematical theorems are given. (auth)

4494

NYO-2389

Princeton Univ., N. J. Project Matterhorn.
A NOTE ON SIGNIFICANCE OF SUMS IN FLOATING-POINT ARITHMETIC. Publication No. 20. Irving N. Rabinowitz. Nov. 1958. 3p. Contract AT(30-1)-1238. OTS.

A floating-point arithmetic algorithm to prevent significance of numbers being lost at both ends, from the right due to digital computer roundoff errors and from the left due to cancellation of nearly equal numbers, is presented. (J.R.D.)

4495

SCTM-22-56(51)

Sandia Corp., Albuquerque, N. Mex.
ON A NONLINEAR DIFFERENTIAL EQUATION ARISING IN MAGNETO-HYDRODYNAMICS. S. Bell. Feb. 3, 1956. 16p. OTS.

One-dimensional compressible flows in magneto-hydrodynamics were recently investigated. Results presented depend on the solution of a nonlinear first-order ordinary differential equation, and in the report two families of numerical solutions of this equation are presented graphically. Results of a study to establish, with bounds for the error terms, asymptotic approximations to the solution of this equation are presented. (auth)

4496

TID-3541

Technical Information Service Extension, AEC.
MONTE CARLO METHOD. A Literature Search.
Raymond L. Scott, comp. Dec. 1959. 13p. OTS.

Unclassified references are included on the Monte Carlo technique of applying statistical methods of random sampling to physical and mathematical problems to which a probability analysis is applicable. References to report and journal literature are given. (W.D.M.)

METALS, CERAMICS, AND MATERIALS

General and Miscellaneous

4497

ANL-5858

Argonne National Lab., Lemont, Ill.
CHEMICAL ENGINEERING DIVISION SUMMARY REPORT [FOR] JANUARY, FEBRUARY, MARCH 1958. June 1958. Decl. Nov. 24, 1959. 132p. Contract W-31-109-eng-38. OTS.

Fluoride Volatilization Separation Process. Corrosion tests were made on a variety of metals to find a material of construction suitable for the fluorination step. All metals tested, with the exception of Hastelloy B, were attacked

rapidly in the fluorinated melt. Further studies were made on the permeation of a six-inch graphite crucible by molten NaF-ZrF_4 . Carrier-free tracer experiments were performed on the behavior of Nb and Ru in the fused fluoride process. Pilot plant operations were directed toward development of two operations basic to fluoride volatility processes, namely, the fused fluoride dissolution of U-Zr alloy fuels and purification of UF_4 by fractional distillation are discussed. Liquid Metal Fuel Reprocessing. The development of a fluoride volatility process to recover and purify the core fluid from the Liquid Metal Fuel Reactor (LMFR) is presented. Corrosion tests of materials of construction having potential use in the fluoride volatility process for reprocessing LMFR core fluid showed Ag, Au, Mo, and Pt to have promise when in contact with hydro-fluorinated NaF-ZrF_4 melts. Fluidization Studies. Work was continued on the fluid-bed drying of zirconium-uranium-fluoride solutions. Laboratory studies were made to evaluate reducing agents which will completely and quickly precipitate the UF_4 in the feed solutions to the fluid-bed driers. Work was continued on fluid-bed calcination of waste solutions. Application of a fluid-bed technique to apply a ceramic-glaze coating on calcined oxide continued. Qualitative mixing studies were started in straight and tapered fluidized bed columns. Pilot-plant study of the fluidized-bed fluorination of UF_4 to UF_6 was begun. Reactor Chemistry. The efforts to clarify the factors involved in the pyrophoricity of reactor materials were continued. Isothermal oxidation studies of U were directed toward understanding the mechanism oxidation which proceeds in two stages attempting correlation with ignition test results. A new procedure to test the ignition characteristics of Zr did not yield satisfactorily reproducible results. Isothermal oxidation studies of Zr alloys were continued. Chemical-Metallurgical Processing. Studies to determine the behavior of tracer-level fission elements in the meltrefining process continued for fuels similar to discharged EBR-II reactor fuel. The distribution of Pu and U for two melt-refining experiments employing "fissium" alloy containing 69 wt. % U-20 wt. % Pu-11 wt. % fissium was followed. A study of the coprecipitation of La by U_2Zn_{17} from liquid Zn was compared. Auxiliary studies were made to determine the optimum container materials, methods of oxidation prevention, phase-separation methods for the utilization of the Pyrozinc processes in large-scale operations. Experiments are in progress to determine the decontamination of irradiated U possible by the use of the Pyrozinc Process. The electrochemical cell study of the U-Zn system yielded data on the free energy of formation of U_2Zn_{17} . Analytical Research and Services. A method was devised for the determination of 0.001% sulfate in UO_3 . The selective dissolution of U from LMFR samples was accomplished by first amalgamating the Bi and then leaching the U with 4M hydrochloric acid-1M hydrofluoric acid. An x-ray spectrochemical analysis for Mo and U in U-fissium alloys was developed. (For preceding period see ANL-5820.) (W.L.H.)

4498 ANL-6041

Argonne National Lab., Lemont, Ill.

MODIFICATION OF CP-5 FUEL ASSEMBLIES FOR FUEL CAPSULE IRRADIATION EXPERIMENTS. W. N. Beck, J. H. Kittel, and F. L. Brown. Nov. 1959. 24p. Contract W-31-109-eng-38. OTS.

The standard vertical fuel tube assembly of the CP-5 research reactor was modified to permit diversion of heavy water coolant into the thimble for temperature-controlled irradiation experiments of capsules containing fuel specimens. The modification entailed revisions to the thimble, outer top shield plug and center shield plug, and helium sweep system. The modified thimble is provided with inlet

and outlet ports which circulate heavy water from the reactor flow system through the thimble cavity. The coolant in the thimble removes fission heat from the encapsulated samples introduced into the thimble cavity. Flow tests of the thimble were first performed on a flow stand, with final flow characteristics being determined in the reactor. A helium purge system was incorporated to remove dissociation gases trapped in the thimble cavity. Four configurations of capsules and capsule baskets were flow tested under conditions simulating operating flow conditions from 2- to 10-Mw reactor power. Irradiation capsules are now being satisfactorily operated in the modified thimbles at 2-Mw reactor power. (auth)

4499 ANL-6048

Argonne National Lab., Lemont, Ill.

EXAMINATION OF JACKETED URANIUM SLUGS FROM THE LOS ALAMOS FAST REACTOR "CLEMENTINE." S. H. Paine, W. F. Murphy, and F. L. Brown. Oct. 1959. 17p. Contract W-31-109-eng-38. OTS.

Work done during period 1950-1953. Final Report of Metallurgy Division Program 6.1.5.

Examination of clad uranium reflector slugs which failed by rupture and swelling during the first year of operation of Clementine revealed no anisotropic damage to the uranium because of burnup or thermal cycling. The cladding was found to be of high-sulfur-free-machining steel, and it is postulated that thermal stresses caused welding flaws to open enough to permit seepage and corrosive attack upon the uranium cores by the reactor coolant (mercury). (auth)

4500 BMI-1400

Battelle Memorial Inst., Columbus, Ohio.

METALLURGICAL STUDIES OF NIOBIUM-URANIUM ALLOYS. John A. DeMastry, Frederic R. Shober, and Ronald F. Dickerson. Dec. 7, 1959. 44p. Contract W-7405-eng-92. OTS.

In a continuing program, fabrication characteristics, physical and mechanical properties, and corrosion behavior in air, CO_2 , NaK, water, and steam were studied for binary niobium fuel alloys containing 10, 20, 30, 40, 50, and 60 wt.% uranium. To evaluate the effects of two major impurities of niobium, oxygen, and zirconium, three niobium base stocks, differing according to the level of these impurities, were used for each alloy. The impurity combinations employed were 600 ppm oxygen and 0.74 wt.% zirconium, 700 ppm oxygen, and 0.17 wt.% zirconium, and 300 ppm oxygen and 0.02 wt.% zirconium. Representative specimens of these alloys retained their hardness up to 900°C. The 10 and 20 wt.% uranium alloys were successfully forged at 2500°F and rolled at 1800°F to sheet. Fabrication characteristics of the remaining alloys are under investigation. The 0.2% offset yield strength of the 10 wt.% uranium alloy was 57,200 psi at room temperature and 36,900 psi at 1600°F. For the 20 wt.% uranium alloy it was 93,200 psi at room temperature and 71,000 psi at 1600°F. The corrosion life of all of the alloys in air at 572°F and in CO_2 at 600°F was superior to that of unalloyed niobium. In 1000-hr exposures to 600°F water most of the alloys exhibited corrosion rates only two or three times greater than that of Zircaloy-2. All of the alloys appear compatible with NaK at 1600°F. The impurity combinations employed in the base niobium appeared to have no effect on the corrosion behavior and mechanical properties of the alloys. (auth)

4501 DMIC-Memo-40

Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio.

A BRIEF REVIEW OF REFRACTORY METALS. R. I. Jaffee. Dec. 3, 1959. 35p.

For presentation at the High-Temperature Symposium at Asilomar, Calif., Oct. 8, 1959.

A review of information on metals whose melting points are equal to or higher than that of chromium (1875°C) is presented. Included are data on physical and thermodynamic properties. Data on sources of supply are also given as well as information on extraction, consolidation, and fabrication. Other aspects such as low- and high-temperature properties, oxidation, and applications are included. (J.R.D.)

4502 IS-47

Ames Lab., Ames, Iowa.

VANADIUM-CHROMIUM ALLOY SYSTEM. O. N. Carlson and A. L. Eustice. Nov. 1959. 18p. Contract W-7405-eng-82. OTS.

On the basis of data obtained from melting point determinations, microscopic examination, and x-ray investigations, a phase diagram is proposed for the V-Cr alloy system. The system forms a complete series of solid solutions with a minimum occurring in the solidus at 1750°C and approximately 70 wt.% Cr. No intermediate phases were found in this system. Hardness and corrosion data are presented as a function of alloying composition. (auth)

4503 KAPL-1181

Knolls Atomic Power Lab., Schenectady, N. Y.

ELECTRODEPOSITION OF NICKEL ON URANIUM. A. P. Beard and D. D. Crooks. Aug. 31, 1954. Decl. Nov. 30, 1959. 34p. Contract W-31-109-Eng-52. OTS.

Electrodeposited nickel coatings on uranium for protection from destructive corrosion in boiling water was investigated. Correlation between the pretreatment of the uranium and subsequent protection by thin nickel coatings was established. Thin electrodeposited nickel coatings provide better protection when applied to a matte surface produced by blasting with an aqueous suspension of silica (100 mesh) followed by a cathodic treatment in 35 wt.% sulfuric acid than when applied to the rough surfaces produced on uranium by anodic pretreatments and acid pickling. Blistering of nickel electrodeposits arising from hydrogen was encountered and eliminated. (auth)

4504 MCW-1439

Malinckrodt Chemical Works. Uranium Div., Weldon Spring, Mo.

THE APPLICATION OF DIFFUSIVITY DATA IN REDUCING THE HYDROGEN CONTENT OF GAMMA-EXTRUDED URANIUM BARS. H. W. Myers, J. W. Varwig, J. L. Marshall, I. G. Weber, and J. A. Kennelley. Dec. 10, 1959. 22p. OTS.

Diffusion coefficients for hydrogen in ingot uranium were determined in the beta and gamma temperature ranges. For ingot metal in the beta region, diffusion coefficients ranged from 4.8×10^{-5} sq cm/sec at 670°C to 6.0×10^{-5} sq cm/sec at 750°C. For the gamma region, values ranged from 6.4×10^{-6} sq cm/sec at 800°C to 1.5×10^{-4} sq cm/sec at 970°C. The activation energy of diffusion was calculated to be 3.6 and 11.4 kcal/g-atom in the beta and gamma regions, respectively. Hydrogen degassing rates for uranium cylinders were significantly reduced when oxide and nitride films formed *in situ* at 900°C. Eight 7-inch-diameter uranium bars produced by gamma extrusion were heated at temperatures to 1575°F while under a pressure of about 200 microns absolute. Heating times varied from 24 to 70 hours. The hydrogen content of the bars, 3.8-7.0 ppm, was reduced to 0.7-2.1 ppm by this treatment. Empirical correlations were developed to predict optimum conditions for degassing gamma-extruded bars of uranium. (auth)

4505 MND-SF-1768

Martin Co. Nuclear Div., Baltimore.

SWAGED METAL FIBER- UO_2 FUEL ELEMENT. Quarterly Progress Report No. 2 from March 15, 1959 to June 15, 1959. Lennart Sundquist. 55p. Contract AT(30-1)-2220, Task III. OTS.

A blending experiment was initiated to determine the effects of blending time and fiber content on the distribution of fibers in a UO_2 matrix. The effects of UO_2 powder characteristics on swaged density and the swaging behavior of sintered particle UO_2 and blends of sintered particle UO_2 and high fired UO_2 were investigated. Results are reported. Experiments were initiated to investigate the effects of swaging temperature, fiber content, and cladding material on the swaged density. The feasibility of producing UO_2 -Mo fiber cores by impregnating fibers with a UO_2 slurry was investigated. An investigation was initiated into the feasibility of incorporating graphite fibers into UO_2 bodies. The fabrication of large diameter samples for thermal conductivity testing was continued. (For preceding period see MND-SF-1714.) (W.L.H.)

4506 NDA-64-102

Nuclear Development Corp. of America, White Plains, N. Y.

EVALUATION OF HIGH TEMPERATURE REACTOR FUEL ELEMENT MATERIALS. B. Minushkin and A. Strasser. Sept. 28, 1956. Decl. Nov. 9, 1959. 63p. OTS.

A number of tests were developed for evaluating fuel element materials for use in a helium cooled reactor at 2500°F. The tests include methods for determining fuel-cladding-atmosphere compatibility and ability to retain fission products at 2500°F. Several potentially useful materials were evaluated on the basis of these tests. A limited effort was devoted to fabrication of test samples of other potentially useful materials. (auth)

4507 NLCO-794

National Lead Co. of Ohio, Cincinnati.

FACTORS AFFECTING YIELD AND METAL QUALITY IN THE REDUCTION OF UF_4 TO METAL. Orville R. Magoteaux and Clarence C. Smitherman. Feb. 18, 1959. 18p. Contract AT(30-1)-1156. OTS.

A study was made to determine the factors which affect yields and metal quality in the bomb reduction of green salt (uranium fluoride) with magnesium to produce massive uranium. Under the conditions of the test, magnesium excess had the greatest effect on crude yields. Six per cent magnesium excess produced higher yields than did 4 or 2% excess. With increased green salt purity, the yields were increased. The best uranium metal quality was obtained with green salt containing 95.5% UF_4 or more. The preheat temperature was prevented from having an effect on yields by minimizing reduction vessel surface temperature differences. Preheat time was controlled by using the same density of slag liner for each reduction. (auth)

4508 NLCO-796

National Lead Co. of Ohio, Cincinnati.

SCOPING STUDIES ON THE ELECTROLYTIC REDUCTION OF MAGNESIUM FLUORIDE. Robert B. Steck and Vincent G. Minutolo. Jan. 15, 1959. 27p. Contract AT(30-1)-1156. OTS.

Laboratory-scale scoping tests on the fused salt electrolytic reduction of magnesium fluoride (MgF_2) have been completed. Magnesium metal of high purity was produced. The electrolytes were: 55 m/o MgF_2 -45 m/o CaF_2 and 27.9 m/o MgF_2 -13.1 m/o CaF_2 -59.0 m/o LiF . The operating temperatures were 980°C (1800°F) and 710°C (1310°F), respectively. The reduction was accompanied by

the evolution of fluorine gas. Concentration of the uranium values in the lower region of the electrolyte was noted. (auth)

4509 NOTS-1335

Naval Ordnance Test Station, Inyokern (China Lake), Calif. PLASTICS AND ADHESIVES: A GUIDE TO THEIR PHYSICAL PROPERTIES AND USES. Lawrence R. Dallett and William E. Donaldson. Oct. 24, 1956. 115p.

All of the more common plastics are briefly described, together with their general properties and applications. In addition the physical properties and pertinent engineering data of a number of representative plastics are listed in tabular form. Methods of fabricating plastics are described, and a section is devoted to the design of molded plastic parts. Stresses which develop in a reinforced plastic tube, under conditions applicable to the design of rocket-motor tubes, are calculated. Adhesives are discussed from both a theoretical and a practical point of view. References are given at the end of each section, and a general bibliography concludes the report. (auth)

4510 NP-8104

Climax Molybdenum Co., New York. MOLYBDENUM METAL. R. R. Freeman and J. Z. Briggs. Oct. 1959. 11p.

A bibliography on phase diagrams of Mo alloys is presented. (W.L.H.)

4511 ORNL-2856

Oak Ridge National Lab., Tenn. APPARATUS FOR DETERMINING LINEAR THERMAL EXPANSIONS OF MATERIALS IN VACUUM OR CONTROLLED ATMOSPHERE. S. D. Fulkerson. Jan. 4, 1960. 39p. Contract W-7405-eng-26. OTS.

An apparatus for determining linear thermal expansion data up to 1350°C for materials that cannot be heated in air is described. Expansion is not measured directly, but is derived from the differential expansion between the material being tested and the materials of construction of the dilatometer. The apparatus is calibrated against published data on the linear thermal expansion of both fused silica and polycrystalline tungsten metal. It can be operated either as a high-vacuum or as a controlled-atmosphere apparatus. Recording of data is either fully automatic or manual. The percentage error is believed to be no greater than ± 0.1 to 0.2%. Original data for linear thermal expansion of materials such as hot-pressed BeO, hafnium-free ZrO_2 , zirconium-free HfO_2 , INOR-8 alloy, silicized silicon carbide, uranium dioxide, compositions of Be + BeO, and samples of CS 312 graphite, boron nitride, and tungsten metal. (auth)

4512 WAPD-216

Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.

PRESSURE TESTING OF ZIRCALOY TUBING. L. F. Cochran. Oct. 1959. 39p. Contract AT-11-1-GEN-14. OTS.

Preceding the construction of the first PWR blanket, it was considered necessary to attempt to determine the probability and consequences of a water-logging accident through pressure tests of the tubular cladding designed to simulate and explore variables encountered in cladding production and reactor operation. Cladding properties and characteristics were determined under test conditions of normal hydraulic loading, dynamic hydraulic loading, cyclic (fatigue) loading, and creep loading; and as a function of fuel clearances, wall thickness, fabrication processes, crack arrestor dimensions, and heat treatment. The tests showed that the bursting strength was affected significantly,

but not greatly, by fabrication processes, rate of loading, and the presence of notches; crack arrestors were not successful and hydraulic shock resulting from failure was not significant. Creep test results showed that the size of the rupture was independent of the amount of water originally introduced in the rod; the fractures were large enough to allow a whole fuel compact to fall out of the rod and to allow the lips of the fracture to contact adjacent rods. The results were instrumental in establishing dimensional tolerance requirements, cold work requirements, and certain processing requirements. (auth)

4513 Y-1258

Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn. COST OF BLENDING URANIUM OF TWO DIFFERENT U^{235} ISOTOPIC ENRICHMENTS. Values of Uranium from the "USAEC Unclassified Pricing List." Oct. 14, 1958. 272p. Contract W-7405-eng-26. OTS.

Cost tables and instructions for calculating the cost of blending two different isotopic enrichments of U^{235} to form an intermediate assay are presented. A sample calculation is included and information on reactor fuel cycles is given. (J.R.D.)

4514

COMMENTS ON THE RECENT PAPER OF CLAREBROUGH, HARGREAVES, AND LORETTO. R. O. Williams (Oak Ridge National Lab., Tenn.). *Acta Met.* 7, 676-7 (1959) Oct.

A comparison is made between the data obtained by Clarebrough et al. and Gordon on the effect of grain size on stored energy in metals as a result of deformation. (C.J.G.)

4515

ON THE THEORY OF SELF-DIFFUSION IN LIQUID METALS. R. A. Swalin (Univ. of Minnesota, Minneapolis). *Acta Met.* 7, 736-40 (1959) Nov.

The theory of diffusion in liquids is considered from the standpoint of the fluctuation theory. It is postulated that diffusion results from the movement of atoms at small and variable distances as a result of local density fluctuations. From geometrical considerations it is deduced that about four atoms besides the diffusing atom are involved in such a fluctuation. The energy of a fluctuation is expressed in terms of the Morse function. An equation for the self-diffusion coefficient, $D = 1.29 \times 10^{-8} T^2 / \Delta H_v \alpha^2 \text{ cm}^2 / \text{sec}$, was derived, where ΔH_v is the heat of vaporization and α is related to the curvature of the potential vs. distance curve. The theory shows no activation energy for the diffusion process. A plot of $\log D$ vs. $1/T$ yields an apparent straight line over a small temperature interval, the slope of which is not a function of the properties of the element but only a function of the temperature of measurement. The relative value of D for various elements is a function of the properties of the elements. The theory is compared with experimental results with the agreement being generally quite good. The theory shows that there is no activation volume in the usual sense but what is measured in pressure experiments is the effect of pressure on the magnitude of fluctuations. The theory, if correct, also implies that thermodynamic properties such as the partial molar heat of solution are important in solute diffusion and may be more important than solute atomic size effects. (auth)

4516

THE EXISTENCE OF A CONTINUOUS TRANSITION OF THE QUADRATIC STRUCTURE TO THE CUBIC STRUCTURE IN THE SYSTEM ZIRCONIA-RARE EARTH

OXIDES. Jean Lefevre, Robert Collongues, and Monique Perez y Jorba. Compt. rend. **249**, 2329-31(1959) Nov. 30. (In French)

The system $ZrO_2-M_2O_3$ (where $M = Nd, Sm, Gd, Yb$) was studied. It was found that, instead of a temperature limit, there is a continuous transition from the quadratic structure of pure ZrO_2 to the cubic structure of solid solutions of the fluorine type. (T.R.H.)

4517

THE FORMATION OF POROUS OXIDES ON METALS.

D. W. Aylmore, S. J. Gregg, and W. B. Jepson (Univ. of Exeter, Eng.). J. Electrochem. Soc. **106**, 1010-13(1959) Dec.

The porosity of the oxide scales formed on a number of metals during oxidation in dry oxygen has been investigated by measurements of specific surface and of density. The oxides formed during the linear oxidation of the eight metals: calcium, cerium, lead, magnesium, niobium, thorium, tungsten, and uranium are porous whereas those formed during the parabolic oxidation of copper and cobalt are impervious to oxygen gas. (auth)

4518

PURIFICATION OF TANTALUM OBTAINED BY VACUUM ARC MELTING.

M. L. Torti (National Research Corp., Cambridge, Mass.). J. Electrochem. Soc. **107**, 33-5 (1960) Jan.

The purest commercially available tantalum powder was consolidated by a single, vacuum, consumable-arc melting operation yielding ingots of considerable higher purity than the original powder. Interstitial and metallic impurity analyses are presented for a large number of heats made under consistent conditions of ingot and electrode size, arc current, and furnace pressure. The effect of carbon addition to an oxygen-rich starting material was investigated, and the optimum carbon-oxygen ratio for maximum refinement was located approximately. Under favorable conditions, the oxygen content is reduced by approximately one order of magnitude. (auth)

4519

SOME METALLURGICAL FEATURES OF NUCLEAR REACTORS.

H. M. Finniston (C. A. Parsons Nuclear Research Centre, Newcastle-upon-Tyne, Eng.). J. Joint Panel Nuclear Marine Propulsion **3**, 17-33(1959) Oct.

Metallurgical features of fuels, canning materials, and pressure vessels of possible nuclear reactors for ship propulsion are examined. The growth and swelling of uranium and its alloys upon irradiation are considered. Fabrication and corrosion behavior of these alloys are discussed. The properties of Al, Be, Mg, Zr, and stainless steels for use as canning materials are discussed. (C.J.G.)

4520

A FUEL ELEMENT FOR AN ELEVATED-TEMPERATURE CRITICAL ASSEMBLY.

Carl E. Walter (Univ. of California, Livermore). Nuclear Sci. and Eng. **6**, 279-83(1959) Oct.

Descriptions are given of elevated-temperature critical-assembly experiments which will utilize stainless-steel-clad fuel elements. The fuel element consists of 0.001- or 0.002-in. thick enriched-uranium foil packaged in a welded 0.002-in. thick type-347 stainless-steel envelope. The design requirements for the fuel elements are stated, as are the considerations which led to the design selected. Beta heat treatment of the uranium was found necessary to provide compatible thermal-expansion characteristics for the two materials in the fuel element. (auth)

4521

SOME APPLICATIONS OF RADIO-ISOTOPES IN THE MECHANICAL AND METALLURGICAL INVESTIGATIONS. Leopold Jurkiewicz (Akademia Górniczo-Hutnicza, Kraków). Nukleonika **4**, 347-63(1959). (In Polish)

The use of radioisotopes in technical investigations is discussed. The influence of radioisotopes on the chemical composition of lubricants which effect the wear of metallic surfaces is described. The uses of radioisotopes in technological processes in the metallurgical industry are reviewed. (C.J.G.)

4522

TRACER DIFFUSION IN A CHEMICAL CONCENTRATION GRADIENT IN SILVER-CADMIUM.

John R. Manning (Univ. of Illinois, Urbana). Phys. Rev. **116**, 69-79(1959) Oct. 1.

Measurements have been made on seven Ag- α AgCd diffusion couples of the diffusion of a layer of radioactive tracer atoms (either Ag^{110} or Cd^{109}) located originally at the Ag-AgCd interface. It was found that the center of gravity of the layer of tracer atoms shifted from its original position, marked by tungsten wires. The shapes of the tracer profiles for Ag^{110} were quite different from those for Cd^{109} . However, for both silver and cadmium tracer, the center of gravity moved toward the cadmium-rich region. A theoretically predicted shift in center of gravity is obtained, taking into consideration the fact that the diffusion coefficient, correlation factor, and chemical potential are functions of chemical composition. The predicted shift in center of gravity arising from the flow of imperfections and the lattice distortion associated with the Kirkendall shift also are considered. Good agreement is found between theory and experiment. Chemical interdiffusion and Kirkendall shift measurements were consistent, within errors, with those predicted by Darken. (auth)

4523

PHOTO-ETCHING MOLYBDENUM FOIL.

H. A. C. Hogg (General Electric Co., Ltd., Wembley, Eng.). Proc. Inst. Elec. Engrs. (London) **105**, Pt. B, Suppl. No. 11, 614-16 (1958) Dec.

The production of an O-band slow-wave circuit for a backward-wave oscillator, using a photo-etching technique, is described. Details of the necessary apparatus are given and the difficulties met in etching molybdenum are discussed. (auth)

4524

SOME PRINCIPLES FOR PRODUCING SOUND Al-7Mg ALLOY CASTINGS.

W. H. Johnson and J. G. Kura (Battelle Memorial Inst., Columbus, Ohio). Trans Am. Foundrymen's Soc. **67**, 18p. (1959).

Principles were developed for the production of sound horizontal castings of the Al-7Mg alloy. They were developed from a study of the relationship that exists between the thermal gradients at the center line of the casting and various conditions such as the size of the casting as well as the location of gates, risers, and chills. Numerous embedded thermocouples established the thermal history during solidification of the castings. The experimental work was performed on elementary shapes—plates and bars. It was found that the feeding range of a side riser decreased as the section thickness increased. Unsoundness occurred when the thermal gradients fell below 5°F per in. The feeding range of an end riser was increased by 50% or more by using wedge-shaped chills on the drag surface of the casting. Chills placed at the end of the casting opposite the riser did not increase the feeding range of the riser.

Marked improvement in tensile properties were obtained on plates that were cast with wedge-shaped chills, as compared with similar unchilled plates that were also sound. Adverse temperature gradients were created by a top riser on horizontal plate castings which were 2 in. thick. As a result, shrinkage occurred in the vicinity of the riser. An insulating sleeve on a top riser increased the degree of soundness somewhat, but did not increase the feeding range of the riser. A marked improvement in soundness was obtained, however, when multiple gates were used with a top riser. (auth)

4525

NATIONAL PHYSICAL LABORATORY SYMPOSIUM NO. 9. THE PHYSICAL CHEMISTRY OF METALLIC SOLUTIONS AND INTERMETALLIC COMPOUNDS. PROCEEDINGS OF A SYMPOSIUM HELD AT THE NATIONAL PHYSICAL LABORATORY ON 4th, 5th, AND 6th JUNE 1958. VOLUMES I AND II. London, Her Majesty's Stationery Office. 1959. 717p.

A compilation of papers given at a symposium on the physical chemistry of metals and alloys is presented. Included are about 50 papers devoted to aspects of experimental methods, metallic solutions, intermetallic compounds, phase transformations, and practical applications. (J.R.D.)

4526

ÜBER DAS FADENWACHSTUM VON ZINK-UND CADMIUMKRISTALLEN. (Whisker Growth on Zinc and Cadmium Crystals). Hans-Peter Mundt. Thesis, Berlin, Technische Universität, 1958. 56p.

Whisker growth on Zn and Cd crystals under pressure was studied. Iron and steel sheet metal was coated with Zn or Cd and pressure was applied. The properties of the resulting whiskers were investigated. A manipulation method was developed which permitted x-ray diagrams of single whisker crystals to be made. The growth of zinc whiskers without the application of pressure was also studied. The temperature dependence of the growth at atmospheric pressure was established. The results are analyzed theoretically. (J.S.R.)

4527

IMPROVEMENTS IN OR RELATING TO THE TREATMENT OF METALS IN POWDER FORM. Philip Bernard Eyre and Joseph Jackson (to United Kingdom Atomic Energy Authority). British Patent 818,191. Aug. 12, 1959.

A powder metallurgy process for preparing small spheres of a metal is described. In the example, 1 kg of 200-mesh U powder was moistened with amyl acetate, sieved and vibrated to form spherical aggregates. These aggregates were dispersed in powdered lime in a stainless steel vessel, warmed to volatilize the amyl acetate, and heated in Ar at 1250°C for 2 hr. The powdered lime was removed and a HNO_3 wash removed oxides. The nitrates were removed with H_2O followed by acetone. The product may be reheated to increase density and improve spherical form and smoothness. (T.R.H.)

4528

REFRACTORY METAL PRODUCTION PROCESS. (to Union Carbide Corp.). British Patent 824,298. Nov. 25, 1959.

A process for producing such metals as Ti, Nb, Zr, Hf, V, and Ta is offered which involves two-stage reduction of a halide. An apparatus consisting of a reaction vessel with an upper and a lower feed nozzle is also described. In one example of the process, 97 lb of Na liquid is raised to 400°C in the reactor in an Ar atmosphere and 416 lb of

TiCl_4 are added by injection at 3 to 20 ft/sec from the top. During this injection the temperature is raised to 850°C. Then 105 lb of Na are injected at the bottom at 6 ft/sec, the temperature being maintained at 850 to 950°C for 2 hr after this addition. Liquid NaCl is then drained and the resulting Ti sponge washed with water. The product was exceptionally pure, containing less than 0.15% O_2 , 0.3% N_2 , and 0.10% Cl. (T.R.H.)

4529

SEMI-CONTINUOUS FUSED HALIDE SALT BATH ELECTROLYTIC PROCESS FOR THE PRODUCTION OF HIGH MELTING POINT REACTIVE METALS. (to Union Carbide Corp.). British Patent 824,316. Nov. 25, 1959.

A fusion electrolysis process for production of Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, and W from their chlorides is presented. In an example of the process, equal weights of NaF and NaCl were fused and 3.65 parts of TaCl_5 are added. Electrolysis at 4 v and 90 amp for 4.65 hr gave 0.992 parts of Ta. More TaCl_5 was added and electrolysis continued at slightly higher voltages and currents. The cathode was changed as necessary. Thus the process is semi-continuous. Other examples are given for Nb and Ti. (T.R.H.)

4530

METHOD OF FORMING URANIUM CARBON ALLOYS. (to United Kingdom Atomic Energy Authority). British Patent 825,041. Dec. 9, 1959.

Two methods of alloying U and C are described. In one, molten U is placed in a C crucible and maintained at the desired temperature to produce the desired composition. In the other method, powdered U and C are mixed, compressed at 20 to 50 psi, and heated at 1800 to 2000°C. (T.R.H.)

Corrosion

4531 HW-27198

Hanford Works, Richland, Wash.
TEST OF WATER VELOCITY ON PITTING OF 72-S ALUMINUM. William C. Houck. Mar. 6, 1953. Decl. Nov. 23, 1959. 4p. Contract [W-31-109-Eng-52]. OTS.

Rotating disk tests were performed on 72-S aluminum tubes to determine the effect of pitting by different types of water. No definite conclusions were reached. (C.J.G.)

4532 HW-59708

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

CORROSION OF ZR-2 AND 304 STAINLESS STEEL FOLLOWING THE TURCO-4501 DECONTAMINATION PROCESS. A. P. Larrick and R. J. Lobsinger. Apr. 20, 1959. 17p. Contract AT(45-1)-1350. OTS.

Investigation at HAPO showed that a proprietary commercial process is one of the more effective methods of decontaminating reactor components exposed to high temperature water. This process consists of a highly alkaline film conditioning bath, a highly alkaline oxidizing bath, and a nitric acid passivation bath. It will remove over 95% of the contamination with relatively low metal losses. The uniform corrosion losses due to the solutions for sensitized and nonsensitized 304 stainless steel are 0.008 and 0.003 mils, respectively, for exposure times of 1 hour in each of the first two solutions and one-half hour in the third solution. Zircaloy-2 and Zircaloy-3b are not attacked by these solutions. No evidences of crevice corrosion or caustic cracking due to the decontaminating solutions were found. A mild intergranular attack was found on sensitized

304 stainless steel. The presence of hydrogen during a special decontamination resulted in large penetrations to Zr-2 and induced breakaway corrosion upon subsequent exposure to pH 4.5, 300°C water. (auth)

4533 IS-48

Ames Lab., Ames, Iowa.

A METHOD OF SPECIMEN CORROSION PROTECTION FOR HIGH-TEMPERATURE CREEP TESTING. J. R. Bohn, R. E. Uhrig, and Glenn Murphy. Oct. 1959. 17p. Contract W-7405-eng-82. OTS.

The method involves encasing the creep specimen in a flexible capsule which is capable of withstanding exposure to the atmosphere for extended periods at up to 1000°C. The capsule consists of several sections of bellows welded to machined parts which comprise the gage point mounting rings and specimen end-adapters. Provisions are made to attach extensometer linkages through the capsule walls to the specimen gage points. A compound system is used to render the desired coupling. (C.J.G.)

4534 NYO-1182

Catalytic Construction Co., Philadelphia.

THE EFFECT OF CHLORIDE ON THE DESIGN AND OPERATION OF NITRIC ACID RECOVERY FACILITIES. Process Engineering Report. F. G. Walters, F. W. Winn, and H. H. Bulkowski. Oct. 15, 1953. Decl. Oct. 7, 1959. 51p. Contract AT(30-1)-1060. OTS.

The effects of chloride on the design and operation of a HNO_3 -recovery facility are summarized. Data are presented on the concentration gradients of chloride ions in fractionators and absorbers, as well as methods for removal of chlorides to eliminate serious corrosion problems. (C.H.)

4535 WADC-TR-58-443

Dayton, Ohio. Univ. Research Inst.

EFFECTS OF MOLTEN BORON OXIDE ON HIGH TEMPERATURE MATERIALS. [Period covered]: February 27, 1957 through February 1, 1958. Charles R. Andrews. Aug. 1958. 146p. Project title: AVIATION FUELS. Task title: FUEL SYSTEM MATERIALS. Contract AF33(616)-3898. OTS.

The corrosive ability of molten boron oxide is presented. A sequence of thirty environmental exposures of high-temperature alloys and ceramic coatings typical of those available for use in aircraft power plants was completed. The static exposure conditions consisted of the cyclic immersion of unstressed test materials in molten boron oxide at 1600 to 2100°F and in atmospheres consisting of air, air containing water vapor, or helium. The results indicate that the presence of aluminum as an alloy constituent or as a surface coating can cause catastrophic corrosion of that alloy at relatively low temperatures. (auth)

4536 AEC-tr-3922

THE EFFECT OF DIFFERENT IMPURITIES ON CORROSION RESISTANCE OF SUPER-PURE ALUMINUM IN WATER AT HIGH TEMPERATURE AND HIGH PRESSURE. A. Domony. Translated from *Acta Tech. Acad. Sci. Hung.* 21, 123-39(1958). 20p. JCL.

Experiments to demonstrate the corrosion of high-purity aluminum alloyed with various quantities of silicon, iron, titanium, and boron are discussed. On the basis of results it is felt that the corrosion behavior of aluminum in mild agents is influenced by the formation of oxide films, the electrochemical behavior of the different phases against the basic metal and by the depolarizing effect of the added metals. In high-temperature, high-pressure water it was concluded that the corrosion behavior was caused by the dissociation of water due to the effects of temperature and pressure. (J.R.D.)

4537

THE ATTACK OF SOLID ALLOYS BY LIQUID METALS AND SALT MELTS. J. D. Harrison and C. Wagner (Massachusetts Inst. of Tech., Cambridge). *Acta Met.* 7, 722-35(1959) Nov.

If one component of a solid alloy is leached out by a liquid metal or salt melt at elevated temperatures, a plane solid-liquid interface is not stable according to a theoretical analysis. Rapidly advancing liquid penetrations were observed in: solid Cu-Ni alloys involving 18 to 87 at.% Cu immersed in liquid Ag at 1000°C with preferential dissolution of Cu; solid Au-Cu alloys involving 67 and 74 at.% Au immersed in liquid Bi at 400°C with preferential dissolution of Au; and solid Ag-Au alloys involving 12 at.% Au from which Ag was dissolved anodically in molten AgCl at 800°C. In contrast, a plane solid-liquid interface was found when Cu-Ni alloys were immersed in liquid Bi at 800°C since the solubilities of Cu and Ni in liquid Bi are about equal. (auth)

Fabrication

4538 ANL-4987

Argonne National Lab., Lemont, Ill.

TECHNIQUES FOR X-RAY EXAMINATIONS OF END-WELD CLOSURES AND CAN-TO-CAP BRAZES ON CP-6 TYPE FUEL ELEMENTS. Final Report—Metallurgy Program 7.7.7. S. S. Sidhu. Jan. 20, 1954. Decl. Nov. 30, 1959. 16p. Contract W-31-109-eng-38. OTS.

Radiographic and fluoroscopic methods were developed for non-destructive testing of CP-6 fuel elements. The methods were designed for examining end-weld closures and cap-to-can brazes for the detection of porosity, cracks, lack of fusion of the weld, non-bonding of the edge, voids, and inclusions. The radiographic method appears the more sensitive of the methods and can detect inclusions of the size 4 by 25 mils deep. The fluoroscopic method is the more rapid of the two and can be used on a production scale. (C.J.G.)

4539 ANL-5161

Argonne National Lab., Lemont, Ill.

EDDY CURRENT AND ULTRASONIC TESTING OF CP-6 FUEL ELEMENTS. W. J. McGonnagle and W. B. Doe. Dec. 1953. Decl. Nov. 30, 1959. 208p. Contract W-31-109-eng-38. OTS.

Nondestructive testing of CP-6 fuel elements using eddy current, ultrasonic transmission, and frost methods for voids and cracks in the Al-Si bonding layer, nonbonded areas, and Al-Si penetration is discussed. The design, operation, and sensitivity of a cyclograph and circuit modifications of multitest methods used in eddy current testing are described. Correlations of results obtained with the cyclograph and slug stripping, ultrasonic, and frost testing methods are presented. (C.J.G.)

4540 ANL-5279

Argonne National Lab., Lemont, Ill.

TESTING OF FUEL ELEMENT PARTS AND ASSEMBLIES BY THE RADIOGRAPHIC METHOD. Robert H. VanderLaan. July 1, 1954. Decl. Jan. 1, 1960. 15p. Contract W-31-109-eng-38. OTS.

A radiographic method for nondestructive testing of welded ends of slug elements is described. Nonbonding, inclusions, and porosity are detected with a high degree of sensitivity. (C.J.G.)

4541 ANL-FGF-148

[Argonne National Lab., Lemont, Ill.].

THE FABRICATION OF THE GRAPHITE-URANIA FUEL FOR THE TRANSIENT REACTOR TEST. J. H. Handwerk,

F. D. McCuaig, and C. H. Bean. Feb. 19, 1959. 24p. OTS.

For presentation at the Nuclear Engineering and Science Conference of the Fifth Nuclear Congress, Cleveland, April 5-10, 1959.

The two predominate methods of dispersing uranium in graphite are reviewed and evaluated. This study indicated that the most feasible method of dispersing uranium in graphite would be to fabricate a mixture of graphite and U_3O_8 bonded with a thermosetting resin. A commercial type graphite was developed through independent research, and this fabrication procedure was adapted for the manufacture of the TREAT fuel matrix. (auth)

4542 BMI-1390

Battelle Memorial Inst., Columbus, Ohio.
EXPERIMENTAL AND THEORETICAL STUDIES OF THE SOLIDIFICATION OF URANIUM CASTINGS. Ellis L. Foster, Jr., Billie L. Fletcher, Charles K. Franklin, Andrew Lechler, and Ronald F. Dickerson. Oct. 28, 1959. 61p. Contract W-7405-eng-92. OTS.

Factors affecting the soundness of large cylindrical uranium ingots cast in graphite molds were studied by means of a mathematical model (utilizing a digital computer) that describes the heat flow during solidification. An experimental technique to accurately measure the temperature at various locations within the solidifying ingot was also developed. This technique involved the use of Ceramo-type, platinum-platinum rhodium thermocouples shielded by small graphite tubes. Additional experiments, although not as quantitative, employed electrical probes to determine the time of gap formation at the mold-metal interface. Variations in pour time, superheat, mold preheat, and outer-mold-wall emissivity were examined by the mathematical model, and it was concluded that these had little effect on the formation of center-line voids for the size of mold and casting being used. The use of the mathematical model for a more complete evaluation of the existing casting parameters and the application of analytical techniques to other materials and casting processes are envisioned. (auth)

4543 HW-58801(Rev.)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

PRTR CALANDRIA SHROUD TUBE BELLOWS—FINAL REPORT, DESIGN TEST PR-24. H. L. Floyd. Aug. 11, 1959. 21p. Contract AT(45-1)-1350. OTS.

For Plutonium Recycle Test Reactor application several methods of attaching aluminum ends to a stainless steel bellows were considered. Brazing, casting, and mechanical attachment tests proved that a method utilizing a titanium bonding layer between the aluminum and stainless steel resulted in high strength with a negligible leak rate. (auth)

4544 NAVORD-3607

Naval Ordnance Lab., White Oak, Md.

CONTROLLED ATMOSPHERE MELTING OF MAGNETIC MATERIALS. J. F. Nachman and W. J. Buehler. Jan. 28, 1954. 17p.

A review is made of the basic equipment required to perform quality controlled atmosphere melting. The equipment described includes a tightly sealed furnace chamber, power source, vacuum pumping system, and gas purification system. A detailed step-by-step melting procedure is given using this equipment. Careful consideration which must be made in the choice of melting crucible and mold wash for different alloys, including two very successful mold wash mixtures, are presented in detail. Furnace charges and the compositions of the final resulting

alloys, for six representative melts, are given. These data indicate the close composition control and minimum of carbon and gases (H_2 , O_2 , N_2) present in these magnetic alloys. The static magnetic results of commercial alloys and those prepared using controlled atmosphere melting are compared and the results tabulated to indicate the superiority of controlled atmosphere melted alloys. (auth)

4545 ORO-224

Clevite Corp. Mechanical Research Div., Cleveland.
FUEL-BEARING FIBERGLAS IN ALUMINUM BASE FUEL ELEMENTS. Quarterly Report No. 2 [for] August 1, 1959 to October 31, 1959. R. H. Baskey. Nov. 15, 1959. 37p. Project No. 50224G. Contract AT(40-1)-2557. OTS.

Hot pressing, cold pressing followed by hot pressing, and vacuum injection casting have been employed to produce fiberglass-reinforced core material. The starting material was aluminum-coated fiberglass. Calculations have indicated that the loading of the core section of a regular MTR fuel plate can be accomplished by using an aluminum-coated fiberglass in which the glass contains 50 per cent U_3O_8 by weight. The aluminum coating would be approximately 60% by volume, while the glass content would be 40% by volume. The unclad fabricated fiberglass-reinforced aluminum has exhibited tensile strengths up to 22,000 psi at room temperature. The elongation and reduction in area were normally less than one per cent. The unclad material normally bent only 7 to 10 degrees around a $\frac{1}{4}$ -in. radius. Cladding this material with 1100 aluminum increased the formability to the extent that it bent up to 90 degrees around an identical radius without breaking. The clad material exhibited reductions in area up to 47%, elongations up to 14%, and tensile strengths up to 19,250 psi at room temperature. Cladding the fiberglass-reinforced aluminum produced blister-free plates. To date, the physical properties of the clad fiberglass-reinforced aluminum have been comparable to a clad plate containing an aluminum-uranium core section. (auth)

Properties and Structure

4546 AD-210960

Carborundum Co. Research and Development Div., Niagara Falls, N. Y.

DEVELOPMENT OF ULTRA REFRACTORY MATERIALS. Progress Report No. 16 [for] November 1, 1958 through January 31, 1959. Peter T. B. Shaffer. Feb. 9, 1959. 30p. Contract NOrd-17175.

A status summary of equipment used on the project is given and a description of all available testing equipment is appended. Progress in materials testing includes preparation of new refractory systems, oxidation testing of refractories based on Zr, Ti, Nb, Sr, and Ba. Thermal shock testing of samples by determining the rate of heating in an oxidation furnace is reported. Refractory systems investigated include $ZrO_2-SiO_2-ZrB_2$, $ZrSiO_4-ZrB_2$, ZrO_2-ZrB_2 , ZrO_2-ZrSi_2 , $ZrB_2-Zr_2Si_3$, ZrO_2-TiC , and Nb_2-NbSi_2 . The pure compounds, niobium diboride and niobium disilicide were prepared by direct reaction of the elements. Properties of these compounds are tabulated. Various zirconates such as that of strontium, calcium, and barium were examined for use as oxidation resistant high-temperature materials. Data on x-ray and spectrographic analyses of these materials are tabulated along with data on oxidation stability. (For preceding period see AD-200603.) (J.R.D.)

4547 BMI-847

Battelle Memorial Inst., Columbus, Ohio.

THE DUCTILITY OF BRAZED STAINLESS STEEL JOINTS.

H. A. Saller, J. T. Stacy, and N. S. Eddy. July 8, 1953. Decl. Nov. 20, 1959. 8p. Contract W-7405-eng-92. OTS.

The ductility of Type 310 stainless steel T-joints brazed with GE-62 brazing alloy was measured. The measure of ductility was taken as the plastic axial strain required to crack braze fillets in T-section tensile specimens. At elevated temperatures, the ductility of as-brazed joints approximated that of the stainless steel, but at room temperature the brazed joints had only 0.1 the ductility of the base metal. Annealing for 16 hr at 1800°F in air was found to triple the room-temperature ductility of the brazed joint. (auth)

4548 BMI-1376

Battelle Memorial Inst., Columbus, Ohio.

SOLUBILITY LIMITS OF YTTRIUM AND THE LANTHANIDE RARE-EARTH ELEMENTS IN CHROMIUM AND CHROMIUM-IRON ALLOYS. Seymour G. Epstein, Arthur A. Bauer, and Ronald F. Dickerson. Sept. 1, 1959. 16p. Contract W-7405-eng-92. OTS.

The solubility limits of yttrium and the lanthanide rare-earth elements in chromium and chromium-iron alloys were investigated at 2300°F and at room temperature. Bases of pure chromium and chromium alloyed with 10, 25, 50, and 75 wt.% iron were prepared with additions of cerium, dysprosium, erbium, gadolinium, holmium, lanthanum, lutetium, neodymium, praseodymium, samarium, terbium, thulium, ytterbium, and yttrium. Most of the elements investigated are estimated to be soluble to the extent of 0.1 wt.% or less in the base alloys. Dysprosium, erbium, and holmium exhibit solubility limits estimated to be between 0.1 and 0.3 wt.%. In general, the solubilities of these elements decreased slightly from 2300°F to room temperature. (auth)

4549 DMIC-Memo-39

Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio.

DEVELOPMENT OF HIGH-STRENGTH STEELS BY WORKING OF METASTABLE AUSTENITE. F. R. Morral. Nov. 30, 1959. 24p.

A summary discussion of incorporating deformation into heat-treating process for development of high-strength steels is presented. On hot-cold-worked steels, such as those conventionally heat treated to martensite, there is a trend of rising strength and falling ductility with increasing carbon content. For aircraft and missile industries, the steels containing 0.30 to 0.40 carbon seem to be most suitable. The effect of particular alloying elements on the behavior of the deformed metastable austenite is not known. The tempering sequence depends on the steels used. It appears that if subcritical deformation of metastable austenite is to become a commercial process, development of plant techniques is necessary. (J.R.D.)

4550 IGR-161(RD/R)

United Kingdom Atomic Energy Authority. Industrial Group H. Q., Risley, Lancs, England.

PLUTONIUM DATA MANUAL. E. L. Francis, comp. June 1, 1959. 44p. BIS.

A compilation of the best available unclassified data on the physical, mechanical, and chemical properties of plutonium and some of its alloys is presented. A list of references (37) cited is appended. (J.R.D.)

4551 KAPL-M-MXB-3

Knolls Atomic Power Lab., Schenectady, N. Y.

STABILITY OF LEAD AND BISMUTH TELLURIDES ON PULSE HEATING TO SUCCESSIVELY HIGHER TEMPERATURES. M. Balicki and F. K. Heumann. Oct. 27, 1959. 15p. Contract W-31-109-Eng-52. OTS.

Presence of a temperature gradient is essential for the operation of thermoelectric generators and other devices. Good thermoelectric materials must be able to withstand such gradients as well as much steeper ones that may develop on fast startups or rapid adjustment of power output. To test the capacity of thermoelectric materials to such service conditions a test procedure was devised and applied to six samples. The test consists of a series of rapid heatings of one end of a sample, while the other end is swept with tap water. On reaching each successive temperature the sample is cooled to room temperature and examined for damage. Samples which show no damage on heating near their melting range are heated near this range again, water quenched, and examined. Of the four samples of n-type and p-type PbTe tested, all failed. One p-type sample disintegrated into three fragments on heating to 410°C. Both samples of (n) and (p) type Bi₂Te₃ passed the test and withstood water quenching from temperatures at which melting started without any apparent damage. (auth)

4552 NASA-TN-D-160

National Aeronautics and Space Administration. Langley Research Center, Langley Field, Va.

COMPRESSIVE AND TENSILE CREEP OF 7075-T6 AND 2024-T3 ALUMINUM-ALLOY SHEET. George J. Heimerl and John Farquhar. Dec. 1959. 41p. OTS.

Results are presented of compressive and tensile creep tests of 7075-T6 and 2024-T3 aluminum-alloy sheet at 300, 375, 450, and 600°F. Various comparisons are made which show that compressive and tensile creep are about the same for both materials in the primary and secondary creep regions except for 2024-T3 aluminum-alloy sheet at 300 and 375°F where the compressive creep was less. At 300°F, the compressive creep was markedly less than tensile creep. (auth)

4553 NASA-TN-D-208

National Aeronautics and Space Administration. Langley Research Center, Langley Field, Va.

AN INVESTIGATION OF NONPROPAGATING FATIGUE CRACKS. Arthur J. McEvily, Jr. and Walter Illg. Dec. 1959. 30p. OTS.

Through consideration of the stresses existing at the tip of a fatigue crack an attempt is made to account for non-propagating fatigue cracks. It is concluded that such cracks may form under constant-amplitude cyclic loading if the crack closes during compression or if the effective radius of the crack is larger than that of the initial notch. The results of experimental work on steel and aluminum alloys compare favorably with predictions. (auth)

4554 NASA-TN-D-212

National Aeronautics and Space Administration, Langley Research Center, Langley Field, Va.

AXIAL-LOAD FATIGUE TESTS OF 2024-T3 AND 7075-T6 ALUMINUM-ALLOY SHEET SPECIMENS UNDER CONSTANT- AND VARIABLE-AMPLITUDE LOADS. Eugene C. Naumann, Herbert F. Hardrath, and David E. Guthrie. Dec. 1959. 37p. OTS.

Sheet specimens with theoretical elastic stress concentration factor $K_T = 4.0$ were tested with the load amplitude held constant or varied by steps to approximate a gust loads history. The test data were analyzed assuming linear cumulative damage, and a limited statistical evaluation was used to confirm conclusions. The value of the summation of cycle ratios $\Sigma n/N$ was found to vary with material, loading sequence, and mean stress. (auth)

4555 ORO-223

Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.

MONTHLY LETTER REPORT NO. 8 COVERING PERIOD

FROM JUNE 15 TO JULY 15, 1959. J. D. Fleming. July 21, 1959. 7p. Project No. B-153. Contract AT(40-1)-2483. OTS.

The studies to determine the influence of firing temperature and firing time on the strength of slip-cast fused silica were completed. The results of these studies are shown. (W.L.H.)

4556 WADC-TR-59-339

Michigan. Univ., Ann Arbor. Research Inst. EFFECT OF PRIOR CREEP ON SHORT-TIME MECHANICAL PROPERTIES OF 17-7PH STAINLESS STEEL (RH 950 CONDITION COMPARED TO TH 1050 CONDITION). Period Covered: January 1, 1958 to March 31, 1959.

Jeremy V. Gluck and James W. Freeman. Apr. 30, 1959. 90p. Project title: MATERIALS ANALYSIS AND EVALUATION TECHNIQUES. Task title: FATIGUE AND CREEP OF MATERIALS. Contract AF33(616)-3368. OTS.

The effect of creep to 2% in 100 hours at temperatures from 600 to 900°F was determined on the tension, compression, and tension-impact properties of 17-7 PH stainless steel (RH 950 Cond.) at room temperature or the exposure temperature. A substantial loss in ductility was observed in room temperature tension tests. Material exposed to creep at 600°F exhibited a substantial Bauschinger effect in tension and compression tests. The loss in ductility is attributed to stress and/or temperature induced aging during the creep-exposure. (auth)

4557 AEC-tr-3918

A STUDY BY THERMAL ANALYSIS OF THE ALLOTROPIC TRANSFORMATIONS OF PLUTONIUM. R. Pascard. Translated from *Acta Met.* 7, 305-18(1959). 19p. JCL.

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 13, as abstract No. 16244.

4558 AEC-tr-3920

INVESTIGATION OF THE SYSTEM Mn-Ce. M. S. Mirgalovskaya (Mirgalovskaia) and I. A. Strel'nikova. Translated from *Trudy Inst. Met im. A. A. Baikova* No. 2, 135-8(1957). 5p. JCL or LC.

This paper was previously abstracted and appears in *NSA*, Vol. 12, as abstract No. 17270.

4559

SOME OBSERVATIONS ON THE RETENTION OF THE β -PHASE IN QUENCHED Zr 50 at.% Ti ALLOYS. B. A. Hatt and G. I. Williams (Fulmer Research Inst. Ltd., Stoke Poges, Bucks, Eng.). *Acta Met.* 7, 682-3(1959) Oct.

The β -phase in Zr-50 at.% Ti alloys was found to be retained upon heating, contamination by air, re-heating, and quenching. It was observed that the β -phase cannot be retained in pure material at the 1000°C/sec quenching rate. (C.J.G.)

4560

COEFFICIENTS OF LINEAR EXPANSION OF ARSENIDES OF INDIUM AND GALLIUM AND TELLURIDE OF INDIUM AND THEIR RELATION TO TEMPERATURE CONDUCTIVITY. N. N. Sirota and L. I. Berger (Kalinin Inst. of Non-Ferrous Metals and Gold, Moscow). *Inzhener.-Fiz. Zhur.*, Akad. Nauk Belorus. S.S.R. 2, No. 5, 104-6(1960) May. (In Russian)

The value and temperature dependence of semi-conductors of the type $A^{III}B^V$ and $A^{II}B^{VI}$ such as InAs, GaAs, and In_2Te_3 were measured. The correlation between heat conductivity and heat expansion in the temperature region below room temperature was conducted on the basis of these measurements. (auth)

4561

THE DONOR-ACCEPTOR INTERACTION OF COMPO-

NENTS IN A BINARY IRON-CHROME ALLOY. I. N. Frantsevich, D. F. Kalinovich, I. I. Kovenskii, and M. D. Smolin (Inst. of Metalloceramics and Special Alloys, Kiev, USSR). *Inzhener.-Fiz. Zhur.*, Akad. Nauk Belorus. S.S.R. 2, No. 9, 62-8(1959) Sept. (In Russian)

A study is made of the reciprocal electrical transfer of Cr and Fe atoms in a binary alloy of iron-chromium by means of radioactive isotope Cr^{51} and Fe^{59} . The investigation was made over the temperature interval 900 to 1200°C. It is shown that in a constant electrical field chromium atoms migrate toward the cathode and iron atoms toward the anode. It was discovered that there is a linear relationship between the effect of electrical transfer and time, if temperature remains constant. Charges and transposition number of migrating elements are calculated for all temperatures according to formulas which were derived. A temperature relationship was established between these values. It is shown that in an iron-chromium alloy a donor-acceptor interaction of components takes place which becomes less marked when temperatures increase beyond 1050°C. (auth)

4562

MULTIAXIAL CREEP STUDIES ON INCONEL AT 1500°F. C. R. Kennedy, W. O. Harms, and D. A. Douglas (Oak Ridge National Lab., Tenn.). *J. Basic Eng.* 81, 599-609 (1959) Dec.

The effect of multiaxial stresses on the creep rate and rupture life of Inconel at 1500°F was investigated. A large range of principal-stress ratios in tension-tension and tension-compression states was studied using axially loaded pressurized tubes. The creep-rate results were compared with both the von Mises (distortion energy) and the Tresca (maximum-shear-stress) criteria. Correlation of the creep-rate results was slightly better using the von Mises criterion; however, the simpler and more conservative Tresca criterion appears to be quite adequate for design considerations. The results of the rupture tests appear to support the maximum principal-stress criterion for time-dependent fracture under multiaxial stress conditions. It was shown, however, that in applying this criterion it is important to compensate for the reduction in rupture life caused by changes in the stress state associated with deformation. Rupture strains were found to be directly related to the deviatoric stresses for constant maximum principal stress. The shear strain at rupture was found to be constant for the same maximum principal stress in tension-tension stress states, thus showing that under these conditions the total ductility of the metal was not impaired by increasing the hydrostatic stress. In tension-compression states, the material sustains greater shear strain before rupture. (auth)

4563

CREEP-RUPTURE STRENGTH OF AUSTENITIC Cr-Ni-Mo STEELS IN SHEET AND BAR FORM. G. V. Smith (Cornell Univ., Ithaca, N. Y.) and F. Garofalo, R. W. Whitmore, and R. R. Burt (U. S. Steel Corp., Monroeville, Penna.). *J. Basic Eng.* 81, 610-16(1959) Dec.

Small variations of the combined amounts of C, N, and P within Type 316 austenitic stainless steel can affect the creep-rupture strength for 100 or 1000 hr measurably. Of the variability in the creep-rupture strength at 1100, 1300, and 1500°F found in testing fourteen different 18 Cr-8 Ni-Mo steels, at least 33 to 54 per cent can be accounted for by variation in the chemical factor, $C + 2.75N + 1.5P$. The additional variability is believed to be related to differences in thermal and mechanical history, perhaps size ef-

fect (ratio of surface area to volume), and to the inherent variability in creep-rupture testing. At 1100, 1300, and 1500°F the 100-hr creep-rupture strength of seven different bar-stock 18 Cr-8 Ni-Mo steels is slightly greater than that of seven sheet-stock 18 Cr-8 Ni-Mo steels when comparing the average deviation between actual and calculated values for the range of the chemical factor, $C + 2.75N + 1.5P$, investigated. The 1000-hr creep-rupture strength at 1100°F is essentially equivalent for both bar and sheet steels. However, at 1300 and 1500°F the bar steels are again found to be slightly stronger. (auth)

4564

CORRELATION OF HIGH TEMPERATURE CREEP AND RUPTURE DATA. Hans Conrad (Westinghouse Electric Corp., Pittsburgh). *J. Basic Eng.* **81**, 617-28(1959) Dec.

The problem of correlating high temperature ($T > 0.45 T_m$) creep and rupture data has been considered in light of the most recent theoretical and experimental information. It is concluded that the deformation of metals and alloys at high temperatures is diffusion controlled and the activation energy is given by the activation energy for self-diffusion of the base metal or diffusion of the alloying constituents. This activation energy should be independent of stress. For low stresses, the dislocation theory predicts a power stress law with an exponent of approximately 4. Experimentally a hyperbolic sine stress law of the form $\sinh [\sigma/\sigma_0(T)]^n$ is very frequently observed over the entire stress range. The change in structure during creep is difficult to predict. It is frequently assumed that it is constant at the minimum creep rate or at the time of rupture. In many cases this appears to be a reasonable assumption, if the stress constant σ_0 is taken as a function of temperature. The equations most frequently employed for correlating creep and rupture data are at variance with one or more of these conclusions, and hence can lead to serious error when used for extrapolating short time data to long times. An equation is presented which correlated high temperature creep and rupture data. (auth)

4565

FABRICATION, PROPERTIES, AND APPLICATIONS OF SOME METALLIC SILICIDES. R. D. Grinthal (Firth Sterling Inc., Yonkers, N. Y.). *J. Electrochem. Soc.* **107**, 59-61(1960) Jan.

The production, fabrication, properties, and applications of compounds of the transition metals with silicon are reviewed. (C.J.G.)

4566

AIR OXIDATION OF TWO REFRACTORY ALLOYS (NICRAL D AND HASTELLOY X) AT 900 AND 1100°C. J. Sannier, R. Dominget, and R. Darras (Centre d'Études Nucléaires, Saclay, France). *J. Nuclear Materials* **1**, 213-25(1959) Oct. (In French)

The oxidation in air of two refractory alloys (Nical D and Hastelloy X) was studied at 900 and 1100°C, by means of recording thermobalances and microscopic cross section examination. At 900°C, the surface oxidation rates of the two alloys are quite similar, but at 1100°C the alloy Nical D oxidizes faster than the alloy Hastelloy X. On the other hand, after heating at 1100°C for 150 hours, Nical D shows both intergranular oxidation and a small amount of internal oxidation, whereas Hastelloy X is especially subject to internal oxidation. In addition, two descaling methods were compared: and electrolytic method, in a sodium hydroxide-sodium carbonate bath, and a chemical method using a sodium nitrate-sodium peroxide bath; the latter appears suitable only for Hastelloy X. (auth)

4567

THE PLUTONIUM-URANIUM SYSTEM. F. H. Ellinger, R. O. Elliott, and E. M. Gramer (Los Alamos Scientific Lab., N. Mex). *J. Nuclear Materials* **1**, 233-43(1959) Oct. (In English)

The plutonium-uranium phase diagram was constructed from thermal, dilatometric, metallographic and x-ray diffraction data. All alloys solidify as a body-centered cubic solid solution, the phase resulting from the complete mutual solid solubility of epsilon plutonium and gamma uranium. Epsilon plutonium is the only plutonium allotrope in which uranium is appreciably soluble, whereas alpha uranium dissolves a maximum of 15 at % plutonium, and beta uranium dissolves about 20 at % plutonium. Two intermediate phases, both having wide homogeneity ranges, exist in this alloy system, and one of them is stable at elevated temperatures only. (auth)

4568

LEAD-LITHIUM SHIELDING ALLOY—METALLURGICAL STUDIES. D. H. Jansen, E. E. Hoffman, and D. M. Shepherd (Oak Ridge National Lab., Tenn.). *J. Nuclear Materials* **1**, 249-58(1959) Oct. (In English)

Alloying and casting studies conducted on a lead-0.69 wt % lithium alloy, a proposed shielding material, are presented. The information obtained was used in making of an experimental, laminated slab, 90 cm square and 10 cm thick. This slab was used to determine the neutron and gamma-ray shielding characteristics of the material. Shielding tests have demonstrated the effectiveness of the alloy in suppressing secondary gamma-ray production. Mechanical property tests were conducted and the results were compared to those for a lead-0.06 wt % copper alloy. It was found that the lead-lithium alloy has superior strength at room temperature, but the lead-copper alloy has superior creep strength at 110°C. Tests at 110°C in air indicate that the lead-0.69 wt % lithium alloy oxidizes more rapidly than pure lead, and is attacked by water with an accompanying volume increase and cracking. Corrosion was much more severe in boiling water than in room-temperature water. The alloy has good rolling characteristics. No cracks or surface defects were observed after rolling to 92.5% reduction. (auth)

4569

THE LATTICE SPACING OF THORIUM, WITH REFERENCE TO CONTAMINATION. D. S. Evans and G. V. Raynor (Univ. of Birmingham, Eng.). *J. Nuclear Materials* **1**, 281-8(1959) Oct. (In English)

In view of the wide range of values reported in metallurgical literature for the lattice spacing of thorium, the effects of contamination, and methods for minimising such contamination, were investigated. Serious contamination, chiefly by nitrogen, was found to occur if the filings are prepared in air. Other stages at which contamination occurs are on exposure to air of filings prepared out of contact with air, on annealing in *vacuo* at pressures as low as 5×10^{-6} mm Hg, and on initial heating up to the annealing temperature by gas evolved from the walls of the boats in which the filings are contained. Unless stringent precautions are taken, results varying from 5.0740 kX to 5.089 kX may be obtained. The necessary precautions are discussed, and it is shown that by preparing filings out of contact with air, and avoiding all contact with air prior to heat-treatment, stress-relief anneals may be successfully carried out in closed or sealed boats of tantalum foil without introducing impurity

in sufficient quantity to affect the lattice spacings by amounts exceeding normal experimental error. The lattice spacing of iodide thorium was determined as 5.0741 ± 0.0002 kX; values in the range 5.078 to 5.082 kX correspond with material highly contaminated or saturated with introduced nitrogen. (auth)

4570

THE ALLOY SYSTEM URANIUM-TITANIUM-ZIRCONIUM. B. W. Howlett (Associated Electrical Industries Ltd., Aldermaston, Berks, Eng.). J. Nuclear Materials **1**, 289-99(1959) Oct. (In English)

The uranium-titanium-zirconium system in the composition range to 40 at. % titanium, 70 at. % zirconium is reported in nine isothermal sections between 575° and 1000°C. The principal features of the alloys are discussed. (auth)

4571

SELF-DIFFUSION OF URANIUM IN THE β PHASE.

Y. Adda, A. Kirianenko, and C. Mairy (Centre d'Études Nucléaires, Saclay, France). J. Nuclear Materials **1**, 300-01(1959) Oct. (In French)

The self-diffusion of U in the β phase was studied using couples of natural U and U^{234} -enriched U. Cylinders 10 mm in diam. were pressed end-to-end at 600°C in vacuum for 1 hr, then heat treated at the temperatures of the experiment for 400 hrs. The samples were then sectioned and penetration-concentration curves were plotted from alpha counting data. Diffusion coefficients determined from these curves are (in cm^2/sec): 5.1×10^{-12} at 700°C, 7.9×10^{-12} at 725°C, 1.1×10^{-11} at 740°C, and 1.6×10^{-11} at 755°C. The existence of covalent bonds is indicated, which explains the observed sharp increase in activation energy of self-diffusion. (T.R.H.)

4572

HABIT PLANES FOR U_4O_9 PRECIPITATION IN URANIUM DIOXIDE. R. H. Tuxworth and W. Evans (Atomic Energy of Canada Ltd., Chalk River, Ont.). J. Nuclear Materials **1**, 302-03(1959) Oct. (In English)

A metallographic examination of fused uranium oxide revealed the presence of a second phase which had precipitated in a Widmanstätten structure along four well defined planes in the matrix. An x-ray powder pattern showed that the matrix was UO_2 and the second phase was U_4O_9 . The same structure was also observed in a sintered uranium dioxide pellet oxidized for 16 hours at 900°C in a static helium and air mixture. (B.O.G.)

4573

HALL EFFECT, RESISTIVITY AND SUPERCONDUCTIVITY OF SOME METASTABLE URANIUM-RICH ALLOYS. T. G. Berlincourt (Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.). Phys. and Chem. Solids **11**, Nos. 1-2, 12-17(1959) Sept.

The Hall effect and electrical resistivity of metastable γ -phase binary alloys of uranium containing 11.6, 21.7, and 30.5 at. % molybdenum and 22.2 at. % niobium were studied between ~1°K and room temperature in magnetic fields up to 30 kG. The Hall coefficients of the latter three alloys were positive and only weakly temperature-dependent, while the Hall coefficient of the 11.6 at. % molybdenum alloy was strongly dependent upon both temperature and magnetic field. All samples exhibited superconductivity below ~2°K and were characterized by weak negative temperature coefficients of resistivity between the transition temperatures and room temperature. Magnetic fields of ~30 kG were required to restore the normal resistivity at 1.2°K. The bearing of the results of this investigation on an understanding of the electronic structure of the γ -phase is discussed. (auth)

4574

THE MECHANICAL PROPERTIES OF SOLIDS, PARTICULARLY METALS, AT TEMPERATURES OF 4.2°K AND BELOW. II. THE FRACTURE OF COARSE CRYSTAL ALUMINUM (99.996%) AND OF THE HIGH STRENGTH ALUMINUM ALLOY B-95. O. V. Klyavin and A. V. Stepanov (Leningrad Physicotechnical Inst., Academy of Sciences, USSR). Soviet Phys.-Solid State **1**, 873-7 (1959) Dec.

Elongation and fracture tests were performed on coarse crystal aluminum (99.996%) and on the high strength aluminum alloy B-95 at temperatures of 4.2 and 1.6°K. The addition of impurities on the base metal at high temperatures leads to increased strength while addition of impurities at low temperatures decreases the strength. (auth)

4575

METAL COMPOUNDS. I. I. Kornilov and B. K. Vul'f (Zhukovskii Aeronautic Engineering Academy). Uspekhi Khim. **28**, 1086-1113(1959) Sept. (In Russian)

The classifications and physico-chemical properties of metal compounds and the conditions of formation of metallic systems and their solid solutions are described. An analysis is made of various types of metal compounds: the Kurnakov compounds; metal compounds with a valence atomic ratio; electron compounds; the Laves phase metal compounds; and the nickel-arsenide phase compounds. Hydrides, borides, carbides, silicides, and nitrides are also discussed. 159 references. (R.V.J.)

4576

IODIDE PURIFICATION OF NIOBIUM. D. M. Chizhkov and A. M. Grin'ko (Baikov Inst. of Metallurgy, Academy of Sciences, USSR). Zhur. Neorg. Khim. **4**, 982-4(1959) May. (In Russian)

Preparation of pure niobium by thermal dissociation of iodide filament at 1300 to 1600°C is described. Properties of iodide niobium are discussed. (R.V.J.)

4577

STABILITY OF THE β PHASE IN Ti-Fe AND Ti-Ni ALLOYS. N. V. Ageev and L. A. Petrova. Zhur. Neorg. Khim. **4**, 1092-9(1959) May. (In Russian)

Phase diagrams of Ti-Fe and Ti-Ni at 700 to 1000°C are plotted. In magnesium thermal alloys with 5.6 wt. % iron and in iodide alloys with 5.7 wt. % Fe the β phase stabilized at 950 and 900°C, respectively; with 7.11 wt. % iron the β phase is annealed at 800°C. In Ti-Ni alloys, the β phase is annealed in magnesium thermal alloys containing 6.98 wt. % Ni and in iodide alloys with 7.6 wt. % Ni at 900 and 800°C, respectively. The β phase stability in alloys with 5.7, 6.34, 6.68, and 7.11 wt. % iron and 7.6 wt. % Ni at -196 to +500°C was studied using x-ray structural analysis, microstructure, hardness, and microhardness methods. (R.V.J.)

4578

CONDITIONS OF β PHASE STABILIZATION IN Ti-Mo-Mn ALLOYS. N. V. Ageev and Z. M. Smirnova. Zhur. Neorg. Khim. **4**, 1100-5(1959) May (In Russian)

The phase diagrams of magnesium thermal Ti-Mo-Mn alloys are plotted at 700 to 1000°C. The β phase stability at 100 to 600°C was studied. In alloys with 17.87% Mn and 4.56% Mo the β phase is stable during soaking for about 100 hours at 100 to 500°C, while in the other alloys the β phase disintegrates into $\beta + \omega \rightarrow \beta + \alpha$ during which the concentrations of Mo and Mn increase and the parameter of the β phase lattice diminishes. (R.V.J.)

4579

INVESTIGATION OF AlSb-AlTe₃ ALLOYS. M. S. Mirogalovskaya and E. V. Skudnova. *Zhur. Neorg. Khim.* **4**, 1113-20(1959) May. (In Russian)

The solid solution of AlSb-Al₂Te₃ was studied and a solidus cross section was plotted. The temperature dependence of electroconductivity, the magnitude of reverse intensity, and the thermoelectromotive force factor were investigated. (R.V.J.)

Radiation Effects

4580 ANL-6059

Argonne National Lab., Lemont, Ill.

EXAMINATION OF IRRADIATED EXPERIMENTAL NRU FUEL RODS. Final Report [on] Program 6.1.25. S. H. Paine and W. F. Murphy. Nov. 1959. 26p. Contract W-31-109-Eng-38. OTS.

Examination of flat, natural uranium plates mechanically clad with aluminum sheaths revealed a tendency for thermal contact between clad and core to diminish as a result of elongation and roughening of the uranium. The assemblies containing beta-quenched uranium showed less damage than those in which material rolled in the high alpha range was used. A clad rod having square cross section was found to have failed by typical internal aqueous attack of the core material. Cause of initial perforation cannot be assigned with certainty. (auth)

4581 KAPL-M-JCC-2

Knolls Atomic Power Lab., Schenectady, N. Y.

THE BURNUP OF EUROPIUM AND DYSPROSIUM UNDER NEUTRON IRRADIATION. J. C. Corelli and F. Feiner. Oct. 29, 1959. 33p. Contract W-31-109-Eng-52. OTS.

Measurements on the fractional change in cross section were made on samples of natural Eu and Dy at the MTR facility. The specimens were exposed to a flux ranging from 2.5×10^{20} to 1.2×10^{21} n/cm². The data were compared to calculated values which were obtained by use of a FORTRAN code written to compute isotopic transmutations occurring as a result of neutron irradiation. For the case of dysprosium the calculated and measured values were in very good agreement, while for europium the agreement was satisfactory. (W.D.M.)

4582 SCR-127

Sandia Corp., Albuquerque, N. Mex.

EFFECTS OF HIGH NEUTRON AND GAMMA FLUXES ON THE TRANSMISSION CHARACTERISTICS OF SOME OPTICAL GLASSES. J. L. Colp and H. N. Woodall. Nov. 1959. 17p. OTS.

The design of the Sandia Engineering Reactor Facility (SERF) presented a unique problem of finding a way to view the virtually unshielded 5 Mw reactor during operation. It was determined that periscope viewing was most feasible. The front optical elements of the periscope must withstand a total integrated radiation dose of 3×10^8 r of gammas, and 1.4×10^7 n/cm², without excessive transmission losses. A program started to study the effects of radiation at such rates and total doses on the transmission characteristics of available optical glasses is described. Curves plotted from the study are presented to show graphically the results of irradiation on these optical glasses. (W.D.M.)

4583 WADC-TR-58-89(Pt.II)

Products Research Co., [Los Angeles].

DEVELOPMENT OF HIGH TEMPERATURE SEALANTS. [Period covered] February 1, 1958 to February 1, 1959. Irvin P. Seegman, William Cheorvas, Francis H. Ingham,

Sarkis H. Kalfayan, Paul A. Mallard, Ron E. Thompson, and R. Loren Varner. June 1959. 192p. Projects 7340 and 3048. Contract AF33(616)-3976, Supplemental Agreement S3(58-2009).

Viton A based fill and drain, faying surface, and filleting sealants were developed which had satisfactory resistance to JP-5 fuel either at 450°F for 168 hrs or at 600°F for 10 hrs, and to oven aging either at 450°F for 168 hrs, or at 650°F for one hr. A Viton A based sealant was developed which had considerable resistance to cycling tests involving exposure to HEF-3 at 260°F and JP-6 Fuel vapor at 450°F. Sealants based on Viton A and on room temperature vulcanizing silicones appeared to be serviceable after gamma irradiation. An injectible groove sealant based on a combination of reverted silastic LS-53U and Fluororubber 1F4 was crosslinked to a rubbery material at 8.71×10^4 ERGS/G.DC. Various materials were studied as Anti-Rads in the various sealant formulations which were developed, but none of these was of any value in improving resistance to gamma radiation. (auth)

4584 NP-tr-323

INCREASE OF THE LEUKEMOGENIC ACTION OF CELL-FREE TUMOR FILTRATES BY COMBINATION WITH X-RAY TOTAL-BODY IRRADIATION. (Steigerung der Leukämogenen Wirkung Zellfreier Tumorfiltrate Durch Kombination mit Röntgen-Ganzkörperbestrahlung). A. Graffi and W. Kriskche. Translated by P. Hajdu (National Institutes of Health, Bethesda, Md.) from *Naturwissenschaften* **43**, 333-4(1956). 4p.

Whole-body x irradiation carried out immediately before or following the injection of cell-free tumor extract increased the incidence of leukemia in mice. (C.H.)

4585

EFFECTS OF FAST NEUTRONS ON THE RECOMBINATION OF "ELECTRON-HOLE" PAIRS IN GERMANIUM. Nguyen Van Dong and Andre Barraud (Centre d'Etudes Nucleaires, Saclay, France). *Compt. rend.* **249**, 2181-3(1959) Nov. 23. (In French)

An attempt was made to determine the positions of recombination levels and the capture probabilities of holes and electrons in N and P type germanium as a result of fast neutron irradiation. (tr-auth)

4586

LIGHT SCATTERING, OSMOMETRIC AND VISCOSITY STUDIES OF THE STRUCTURE OF POLYSTYRENE SUBJECTED TO γ -RADIATION. I. G. Soboleva, N. V. Makletsova, and S. S. Medvedev (Karpov Scientific-Research Inst. of Physics and Chemistry). *Kolloid. Zhur.* **21**, 625-9(1959) Sept.-Oct. (In Russian)

The structure of polystyrene subjected to the action of γ rays was investigated with the aid of light scattering, osmometric, and viscosity techniques. Irradiation of benzene solutions of polystyrene causes a considerable broadening of the molecular weight distribution with predominance of the lower molecular weight fraction, the linear structure of the molecular chains being disrupted. Experiments with polystyrene containing radioactive carbon (C¹⁴) indicate recombination of polymer radicals following irradiation of dilute solutions. (tr-auth)

4587

NEUTRON AND FISSION FRAGMENT DAMAGE IN ZIRCONIA. J. Adam and B. Cox (United Kingdom Atomic Energy Authority, Harwell, Eng.). *Phys. Rev. Letters* **3**, 543-4(1959) Dec. 15.

No phase transformation was reported for pure ZrO₂ under neutron bombardment. A monoclinic-to-cubic phase

change was observed in oxidized zirconium alloys containing up to 5 wt. % of either vanadium, chromium, or tantalum under moderate neutron doses. (C.J.G.)

4500

FREE-RADICAL CONCENTRATIONS AND OTHER PROPERTIES OF PILE-IRRADIATED COALS. R. A. Friedel (Bureau of Mines, Pittsburgh) and Irving A. Breger (Geological Survey, Washington, D. C.). *Science* **130**, 1762-3(1959) Dec. 25.

Five coals reacted quite differently when they were exposed to pile-irradiation. Little or no change was found in free-radical content for the three coals of lowest carbon content, whereas the two coals of highest carbon content were found to have a considerable increase in free-radical content. The infrared spectra and the apparent hardness of the irradiated coals of higher carbon content indicate that polymerization occurred. Radiation of these coals in chemical reagents may promote reactivity. (auth)

4509

THERMAL EMISSION AND DECOLORIZATION IN X-IRRADIATED QUARTZ. E. N. Batrak (Inst. of Crystallography, Academy of Sciences, USSR). *Soviet Phys.-Cryst.* **3**, 635-6(1959) Dec.

The introduction of lithium ions to a rose quartz crystal was found to have no effect on the thermal emission. The introduction of sodium ions caused the original maximum thermal emission at 178°C to vanish and establish a maxima at 308°C. Two absorption bands with their maxima at 450 and 630 mμ were found which indicate that absorption bands in the visible region are caused by electrons trapped at levels by Li and Na ions. (C.J.G.)

4590

STRUCTURAL MODIFICATIONS INDUCED IN RUBBER BY NEUTRON IRRADIATION OF RUBBER SOLUTIONS. Cl. S. Nicolau (German Academy of Sciences, Berlin). *Z. physik. Chem. (Leipzig)* **212**, No. 1-2, 1-9(1959). (In English)

The effects of neutron irradiation on rubber were studied using natural rubber-crepe deproteinized and dissolved in benzene to give a concentration of 0.5 g rubber/100 cc benzene. A Po-Be source containing 1 c Po was the neutron source. The results showed that no structural modification occurred in the solutions after 200 hr of irradiation. After 200 hr of irradiation of a rubber solution in benzene-0.02M triphenylmethane, the percentage of double bonds in the rubber decreased 44.1%. The value agrees satisfactorily with the theoretical value calculated for complete cyclization. In the infrared absorption spectrum of the rubber irradiated in benzene-triphenylmethane solution, new bands characteristic of the cyclized and post-irradiation oxidized rubber appeared. (J.S.R.)

4591

ELEKTROLYTISCHE TRANSPORTVORGÄNGE IN FESTEN METALLEN UND LEGIERUNGEN. (Electrolytic Transport Processes in Solid Metals and Alloys). Hans Wever. Berlin, Technische Universität, 1958. 72p.

Electrolytic transport processes were studied in pure copper, iron, and nickel and in the mixed crystals Cu/Al and Cu/Sn. A quantitative description is given of the transport phenomena, and their causes are considered in some detail. The experimental results are discussed on the basis of d-c and a-c research and of thermodiffusion. Surface transport phenomena are also described. The mechanism of the transport process is studied in each case. (J.S.R.)

PHYSICS

General and Miscellaneous

4592 AECU-4508

Los Alamos Scientific Lab., N. Mex.

IDEAL GAS THERMODYNAMIC PROPERTIES OF DETONATION PRODUCTS. Charles L. Mader. Sept. 1959. 206p. (GMX-2-R-59-3). OTS.

The ideal gas thermodynamic functions $(F^0 - H_f^0)/T$, H_f^0 , and S^0 were computed at various temperatures in the temperature range from 300 to 6000°K for some of the molecular species of interest in detonation performance calculations. The molecular species are composed of the atoms chosen from among the following: Al, B, Be, C, Cl, F, H, Li, Mg, N, and O. The method of least squares was used to determine the parameters of a cubic equation which expresses the dependence of these thermodynamic functions on temperature. (auth)

4593 AECU-4518

Stanford Research Inst. Poulter Labs., Menlo Park, Calif. FINITE AMPLITUDE STRESS WAVES IN ROCKS. Technical Report 012.59. D. R. Grine. Oct. 1, 1959. 64p. OTS.

Rock fracturing by high-amplitude pulses and the effects of such fracturing on pulse propagation were investigated. Explosive-initiated high-amplitude pulses in cylinders of three different rocks and two concretes were studied to determine the pulse amplitude needed to damage the cylinders. The decrease of maximum axial stress with distance traveled by pulses along cylinders was calculated from observations of pulse propagation velocity and particle velocity. This decrease was used as a measure of pulse attenuation in the media tested. A nonporous greywacke was not damaged by a compressive pulse with axial stress 6.7 times the static compressive strength of the rock. The porous media were destroyed by pulses with axial stresses less than twice their static strengths. High porosity leads to fracture at low dynamic stresses. Maximum stress levels in pulses in porous media decreased about twice as rapidly as in nonporous media. Although porosity was not the only difference between the media with high and low attenuation, it was probably the controlling difference. An average high-amplitude wave velocity of half the elastic wave velocity was observed in a porous limestone. Elastic theory is not expected to apply to a wave fracturing a rock. Rapid decreases in original free surface velocity of the greywacke rock indicate that this rock sustained tensile stresses about a hundred times greater than its probable tensile strength for times as long as fifty microseconds. (auth)

4594 AERE-R-2941

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

THE URANIUM SPECTRUM BETWEEN 3500 Å AND 5500 Å WITH ASSOCIATED ISOTOPIC SHIFTS. E. W. T. Richards and M. D. Crew. Sept. 1959. 205p. BIS.

Experiments are described which were carried out in an attempt to increase the fundamental knowledge of the U spectrum and because of the growing tendency to perform isotopic abundance measurements by means of emission spectroscopy. Information is given as to the wavelengths and relative strengths of the spectral lines in the region chosen and the isotopic shifts. The experiments were limited to the isotopes U^{235} and U^{238} . The 21 ft spectrograph at Harwell was used as a photographic instrument. (W.D.M.)

4595 AERE-T/M-37

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.

ON THE ENERGY SPECTRUM OF INELASTICALLY SCATTERED NEUTRONS. B. H. Flowers. Mar. 10, 1950. 5p.

Formulas representing the spectrum of inelastically scattered neutrons and based upon a statistical theory of the nucleus are discussed. A simple formula is proposed which, while differing somewhat from the conventional Maxwellian distribution, still only involves one unknown parameter. (auth)

4596 ANL-6064

Purdue Research Foundation, Lafayette, Ind.

AN INVESTIGATION OF CERTAIN THERMODYNAMIC AND TRANSPORT PROPERTIES OF WATER AND WATER VAPOR IN THE CRITICAL REGION. E. S. Nowak and R. J. Grosh. Oct. 1958. 102p. For Argonne National Lab. Contract W-31-109-eng-38, Subcontract 31-109-38-704. OTS.

An accurate knowledge of thermodynamic and transport properties of water in the critical region is required in order to analyze future power cycles, nuclear reactor configurations, and other types of heat transfer apparatus. Preliminary investigations showed that this was not possible with presently existing tabulations. Experimental data from volumetric viscosity and thermal conductivity studies were therefore selected and retabulated. Smoothings of these data are described and, for the first time, a tabulation at close intervals of pressure and temperature of the volumetric data is possible for steam in the critical region. A graphical presentation is given of volumetric data from 700 to 750°F. An important result of this study was that excellent agreement existed between the many P-V-T measurements for this substance even though some of the data was obtained many years ago. Differences occurring between the tabulated data of various steam tables were found to arise from the use of inexact equations of state or interpolation techniques rather than from faulty primary data. New P-V-T data were derived from measurements of other investigators, by a graphical technique and it is estimated that it yielded pressure values accurate to some five parts in ten thousand except in the subcooled liquid region (for specific volumes below 0.040 ft³/lb), where the uncertainty may be some twenty parts in ten thousand. Study of the existing thermal conductivity and viscosity data suggests that the Russian work is the most consistent. However, it appears that the empirical equations proposed for interpolation do not adequately represent the data in the critical region. No attempt has been made to derive thermodynamic functions or to analyze the transport data. (auth)

4597 APAE-Memo-184

Alco Products, Inc., Schenectady, N. Y.

REFLECTOR AND PRESSURE VESSEL COOLING AND THERMAL STRESS ANALYSIS ON THE IBM 650. J. D. Love and R. L. Caton. Mar. 26, 1959. 37p. Contract AT(30-3)-328. OTS.

These programs are intended to assist in establishing reflector cooling requirements, as well as thermal stresses in the reflectors and pressure vessel. The main program (304-Rec I) establishes required velocities between reflectors as a function of geometry, heat generation rates, material and fluid properties, and allowable surface temperature. This is done by iterating on velocities for successive water gaps. When required velocities have been established, corresponding thermal stresses are calcu-

lated. Rec II (301) and Prev I (301A) are supplement programs. Rec II is utilized for establishing surface temperatures of a reflector as a function of velocities, geometry, heat generation rates, and material and fluid properties. It handles only one reflector per case. This program also calculates thermal stresses in the reflector. Prev I is intended for calculations concerning a pressure vessel, perfectly insulated at the outer surface. It calculates surface temperature and thermal stresses in the vessel as a function of velocity, geometry, heat generation rates, and material and fluid properties. All calculations are performed at the midplane, where maximum heat generation rates occur. (auth)

4598 ARGMA-TN-1C1N-23

Army Ordnance Missile Command, Redstone Arsenal, Ala. RESEARCH LABORATORY QUARTERLY RESEARCH REVIEW NO. 23 [FOR] AUGUST 1, 1959 THROUGH OCTOBER 31, 1959. Dec. 1, 1959. 84p.

An analysis of the Rosser rocket function is presented. Construction of a neutron long counter for monitoring purposes is reported. The neutron yield from $\text{Li}^7(p,n)\text{Be}^7$ in the forward direction as a function of proton energy was measured and cross sections for the $\text{Zn}^{64}(n,2n)\text{Zn}^{63}$ and $\text{Ag}^{107}(n,2n)\text{Ag}^{106m}$ reactions were also measured using an accelerator. The neutrons at 12.2 to 18.1 Mev were produced by the $\text{T}(d,n)\text{He}^4$ reaction. Normalized data are presented graphically. Progress in analysis of plasma jet arcs is reported. The radiation from the arc column is being studied spectrographically as a function both of the distance from the cathode along the axis of the arc and radial position in the arc column. Arcs in argon, argon and deuterium, helium, and helium and deuterium were studied. Data on the partition function for hydrogen, helium, nitrogen, carbon, oxygen, sodium, and calcium were calculated at 10,000 to 80,000°K. A high-speed compression machine was developed to test polymers at high strain rates. The machine is described, and preliminary relative to compressive properties are given for the thermoplastic polyethylene and ethyl cellulose. Analysis of a type of rocket motor combustion oscillations known as high frequency screaming is being investigated by measuring the flame propagation velocity down the combustion tube. The butane-oxygen-nitrogen system was used for the study. The experimental data show a correlation of the tendency of oscillation self-excitation with the velocity of flame propagation. Additional study of turbulence, transition to turbulence, and growth of turbulence in flames as possible mechanisms of disturbance amplification is indicated. Study of the combustion of $\text{N}-\text{C}_4\text{H}_{10}$ with WF_3 is being conducted and results indicate that WF_3 attaches to carbon through the formation of a C-N bond. The fluorine atoms react with hydrogen atoms to produce HF, and the oxygen attacks the carbon skeleton. (For preceding period see ARGMA-1C1N-22.) (J.R.D.)

4599 BRLM-1227

Ballistic Research Labs., Aberdeen Proving Ground, Md. RESPONSE OF BRL SELF-RECORDING PRESSURE-TIME GAGES TO SHOCK WAVES PRODUCED BY DETONATIONS OF M15 ANTITANK MINES. J. G. Schmidt. Aug. 1959. 60p. DA Project No. 598-09-003.

The Ballistic Research Laboratories self-recording pressure-time gage and electronic gages were used to measure the magnitude and duration of the shock waves produced in air as the result of the detonation of one or more M15 AT mines buried under six inches of earth. The results show that the self-recording gage possesses sufficiently rapid response to measure the air blast produced

by the detonation of the mine and that this pulse can be resolved if it is superimposed upon a blast wave of much longer duration. The report includes graphs showing the pressure versus time as measured by the self-recording gage and pressure wave shapes determined by the electronic gages. (auth)

4600 DP-427

Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.

IBM 650 ROUTINE V—A MULTIGROUP P_3 PROGRAM FOR THE NEUTRON TRANSPORT EQUATION. Richard R. Haefner. Oct. 1959. 63p. Contract AT(07-2)-1. OTS.

A description is given of an IBM-650 routine that computes the spherical harmonic approximation to the neutron transport equation in five energy groups, in one dimension, and for cylindrical geometry. The P_3 approximation is used for the lowest energy group and the P_1 approximation is used for the higher energy groups. (auth)

4601 KAPL-M-ELW-12

Knolls Atomic Power Lab., Schenectady, N. Y.
THIN REGION THEORY FOR SYMMETRIC SANDWICHES.
E. L. Wachspress. Nov. 25, 1959. 8p. Contract W-31-109-Eng-52. OTS.

Proximity of thin regions in a lattice affects the parameters through neutron anisotropy at surfaces. The sandwich problem of two identical thin regions separated by another region which may have an internal source is considered. Symmetry about the central region is assumed and it is shown that a point must be introduced internal to each poison region in order that the scheme conform to existing codes. Various cross sections are derived and it is demonstrated that limiting cases are consistent with previous analysis. (W.D.M.)

4602 KAPL-M-MXB-2

Knolls Atomic Power Lab., Schenectady, N. Y.
PRELIMINARY VERSION OF A METHOD FOR ASSAYING SUITABILITY OF THERMOELECTRIC SUBSTANCES FOR DIRECT CONVERSION OF FISSION TO ELECTRICAL ENERGY. M. Balicki. Sept. 21, 1959. 17p. Contract W-31-109-Eng-52. OTS.

In order that irradiation testing be confined to the most promising materials, a reliable method is needed for arranging all candidate thermoelectric materials in order of their potential suitability for reactor service. A method is presented for discussion which apparently when fully developed promises not only to solve the problem of screening out the less attractive materials but also to reveal which of the materials screened are the best ones. The method is based on the vector addition of twenty parameters. (W.D.M.)

4603 NASA-TR-R-5

National Aeronautics and Space Administration. Lewis Research Center, Cleveland.

APPLICATION OF MORSE POTENTIAL FUNCTION TO CUBIC METALS. Louis A. Girifalco and Victor G. Weizer. 1959. 16p. GPO.

The Morse parameters for the pairwise interaction of atoms in cubic metals were calculated from experimental values of the energy of cohesion, the lattice constant, and the compressibility. The equation of state and the elastic constants computed from the Morse parameters were shown to be in agreement with experiment. The Born stability conditions were also satisfied by both the face-centered and body-centered metals. The Morse function thus was found to be applicable to problems involving any type of deformation of the cubic metals. (auth)

4604 NP-8124

Utah. Univ., Salt Lake City.

A STUDY OF IONIZATION IN THE TRAIL OF ULTRA-SPEED ALUMINUM PROJECTILES. Interim Technical Report No. 11 on: INVESTIGATION OF IONIZATION ASSOCIATED WITH ULTRA-SPEED PELLETS. J. F. Piccolo, R. W. Grow, R. R. Kadesch, and E. T. Cannon. July 1959. 73p. DA Project No. 5B99-01-004. Contract DA-04-495-ORD-451.

A 0.220-caliber smooth-bore gun, six ionization probes, and a vacuum range were used to investigate the behavior of ionization, in the trail of ultra-speed projectiles, as a function of the pressure of the medium through which the projectiles were accelerated and as a function of the distance from the end of the accelerator to the ionization probes. The ionization near the end of the gun barrel was about 10^{14} electrons per cubic centimeter at atmospheric pressure. This value decreased to 10^{13} e/cc at 106 cm. (W.D.M.)

4605 NP-8140

Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics.

ON THE STATE OF A FERMI-SYSTEM OF PAIRS OF PARTICLES WITH PARALLEL SPINS. [PART] I.

Zygmund Galasiewicz. 1959. 13p.

The solution of a compensation equation of dangerous graphs, for a system of interacting Fermi particles, as an odd function of wave vectors is investigated. It is shown that this solution leads to the anomalous state the energy of which is smaller than the energy of the normal state. The energy difference is equal to the binding energy of the pairs of fermions with parallel spin-moments. This anomalous state can exist in the presence of the repulsive Coulomb interactions. The elementary excitations are separated from the ground state by a gap the width of which depends on the direction of the wave vector. For the direction perpendicular to the spin direction, energy gap is zero and therefore the state cannot be superconducting. The binding energy of the pairs and the width of the energy gap are of the same order as in the theory based on the creation of pairs with antiparallel spin-moments, where in the expansion of the interaction term in spherical harmonics, the first coefficient is more than three times greater than the zero coefficient. In the absence of the magnetic field the total spin of a system is zero. In the presence of the magnetic field the total spin differs from zero. The paramagnetic susceptibility is calculated. (auth)

4606 NP-8148

Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw.

EXPERIMENTS ON THE PRODUCTION OF "COLD" NEUTRONS. Report No. 97/I-B. D. O'Connor, E. Maliszewski, and W. Bedefek. July 1959. 11p.

The moderation to low energies of neutrons emerging from the thermal column of the EWA reactor in hydrogen-containing substances has been investigated. Measurements of the energy of scattered neutrons were performed at room and liquid nitrogen temperatures using absorption and time-of-flight methods. The shift of the neutron spectrum to long wavelengths was demonstrated. (auth)

4607 ORNL-2775

Oak Ridge National Lab., Tenn.

MEASUREMENT OF STOPPING POWER OF COPPER BY CALORIMETRIC METHODS (thesis). P. L. Ziemer, R. M. Johnson, and R. D. Birkhoff. Jan. 4, 1960. 117p. Contract W-7405-eng-26. OTS.

Submitted to Vanderbilt Univ.

The electron stopping power of copper was determined by measuring directly the power dissipated as heat in a copper foil by a transmitted beam of monoenergetic electrons. Monoenergetic electrons from an electron gun were accelerated by a linear accelerator and impinged normally on a 191.8 microgram per square centimeter copper foil. The electron beam was varied from 31.56 to 126.56 kev in steps of 10 kev, and the heating effect was determined at each energy. The power dissipated as heat was measured using a set of six copper-constantan thermocouples. The ratio of this power loss to the current of the electron beam passing through the foil gave the average energy loss, ΔE , for each incident energy. The thermocouple system was calibrated by lowering the beam energy below 2.5 kev so that the beam was completely absorbed in the foil. Foils were prepared by vacuum evaporation onto a water soluble coating on a glass slide. Details of technique of evaporation and mounting are given. The path length for the bombarding electrons corresponded to the foil thickness, Δx , and was determined by weighing a known area (0.987 cm^2) of foil. Corrections were made for single and multiple scattering effects, and the stopping power was then given by the ratio $\Delta E/\Delta x$. The probable error was calculated and found to be 3.7%. For all energies examined agreement was found with Bethe's expression for electron stopping power. (auth)

4608 ORNL-2829

Oak Ridge National Lab., Tenn.

SOLID STATE DIVISION ANNUAL PROGRESS REPORT
FOR PERIOD ENDING AUGUST 31, 1959. Dec. 11, 1959.
237p. Contract W-7405-eng-26. OTS.

Theory of Radiation Damage: The classical scattering of an energetic, moving lattice atom from a stationary lattice atom was investigated in detail. The results are of general interest since the method used is limited only by the validity of the interatomic potential assumed. Cross sections for the displacement of lattice atoms by gamma rays up to 5 Mev were calculated. A theoretical study was made of the slowing down process for a primary displaced atom in a solid. The small amplitude motion of dislocation loops was investigated in detail, taking into account the whole elastic field interaction between different parts of the loop. The extension and interval correlations in a radiation-induced displacement cascade were investigated. The numerical data apply to copper. A special model for annealing of defects in solids is discussed. Dislocation Interactions: Studies were made of the variations of internal friction and elastic modulus during irradiation of pure copper crystals at a number of temperatures in the range 90 to 300°K. Using neutron irradiation as a tool, it is shown that there are at least two dislocation contributions to the Young's modulus and internal friction of Cu at low temperatures. An apparatus was developed which makes possible the continuous observation of the Young's modulus and internal friction of a metal sample. Low-temperature Irradiation Studies: Activation energies for the annealing of copper and aluminum following reactor bombardment near 4°K were measured. Isochronal annealing studies of Cu, Ag, Au, Pt, and Zn were made after neutron bombardment of these materials at 4°K. It was confirmed that the residual resistivity of high purity copper can be greatly reduced by annealing in an oxidizing atmosphere. A redermination of the stored-energy release in reactor-irradiated Cu between 30 and 50°K was made. The design of a new facility for irradiation damage experiments at very low temperatures is described. A helium-cooled facility was installed in the pool of the ORR, which allows

samples to be irradiated at about 50°K in an inert atmosphere. Electron Microscope Studies: Fission fragment tracks in thin films of UO_2 were studied and found to be essentially a surface effect in which material at the surface is displaced as a result of the passage of the fission fragments. An improved replication technique for copper is described. Chemical Properties of Metal Surfaces: The kinetics of the dissolution of copper crystals in aqueous solutions were investigated. The diffusion of deuterium in deuterium-irradiated Cu was studied in the temperature range $-50 < T < 50^\circ\text{C}$ by monitoring neutrons from the D(d,n)He^3 reaction. Alloy Studies: Experiments were conducted on the effect of irradiation on atomic rearrangements in Cu-Al, Ni-Be, Ni-Cu, Au-Cd, and Fe-C. Semiconductor Studies: A model for the potential well surrounding disordered regions in neutron-irradiated Ge and Si is discussed. The different effects of Co^{60} gamma-ray and fast-neutron bombardment on the electrical behavior of Ge are discussed in terms of the distribution of lattice defects. Thermal neutron capture in Si and Ge is considered. The effect of neutron and gamma irradiation upon minority carrier lifetime in Ge was studied. The effect of 14-Mev neutron irradiation upon the electrical properties of Ge was studied. A preliminary study was made of the change in thermoelectric power of n-type germanium as a result of neutron irradiation. Annealing of radiation-induced conductivity changes in n-type Ge was found to take place in the range between 77 and 273°K. The charge-center concentration as a function of temperature of high-purity, n-type Ge under fast-neutron irradiation is compared to similar data obtained for Co^{60} gamma-ray irradiations. The diffusivity, solid solubility, and acceptor behavior of Cu in Ge was investigated. The effect of neutron spectrum on conductivity changes in n-type Ge was investigated. Hall coefficient and Hall mobility were measured as a function of temperature and Co^{60} gamma irradiation on a number of n-type Si samples. The magnetic susceptibility of donor centers in semiconductors was calculated for the case of small interactions between closely adjacent donors. Preliminary measurements of the magnetic susceptibility of AlSb were made. Insulating Crystals: Fast neutron and gamma coloration in KCl was investigated. Vacuum ultraviolet absorption in irradiated silica and quartz and irradiation effects and short-range order in silica and quartz were studied. Nonmetallic crystals with a variety of structures and chemical compositions were exposed to fission-spectrum neutrons in core positions of the LITR and examined by x-ray-diffraction techniques. Fission fragments were observed to cause a phase transition of monoclinic ZrO_2 to the cubic form. The temperature dependence of the magnetic susceptibility of K_2ReCl_6 was measured between room temperature and 5°K. Polymers and Ceramics: The decrease in molecular weight of polymethyl methacrylate after irradiation was followed for periods up to 500 hr. The irradiation of specimens of polystyrene of 0.010 and 0.080 in. thickness indicates that the thin specimens undergo cross-linking at a greater rate than the thick specimens. Deuterated basic beryllium acetate complex was irradiated for doses up to $2.9 \times 10^{22} \text{ ev/g}$ at a thermal-neutron flux of $6 \times 10^{11} \text{ n/cm}^2 \text{ sec}$ to given neutron doses up to $1.6 \times 10^{16} \text{ n/cm}^2$. The effect of an exposure of $2 \times 10^{20} \text{ nvt}$ in the ORR on the thermal stability of asbestos was studied. The energy absorbed in H and C from fast neutrons and gamma rays was calculated from colorimetric measurements made in holes 19 and 51 of the ORNL Graphite Reactor. The relative efficiencies of neutrons and gamma rays in polymer irradiation effects were determined. A cryostat was in-

stalled in Hole 50 of the ORNL Graphite Reactor. An irradiation-program is under way to evaluate the stainless steel-canned UO_2 fuel element for the EGCR. A high-temperature oxidation-resistant cladding (SiC-Si) for graphite was studied for thermal and radiation stability. A new program to study irradiation embrittlement of metals was begun. Commercial carbon steels irradiated at temperatures up to 330°F exhibited a rise in notch-impact transition temperature that is linear with the logarithm of the fast neutron dose from 10^{18} to 10^{20} nvt. Tube-burst tests on Inconel were continued in the ORR. (For preceding period see ORNL-2614.) (W.D.M.)

4609 PB-151796

AeroChem Research Labs., Inc., Princeton, N. J. ADVANCED PROPULSION SYSTEMS. A Preliminary Study. Technical Publication No. 6. H. F. Calcote. July 1958. 100p. Contract Nonr-2336(00). OTS.

A critical study was made of some advanced propulsion systems with particular attention to the propulsion motor and the power source as separate units. The primary objectives were to evaluate the state of the art and estimate fruitful lines for future research. The general principles of propulsion as they pertain to non-conventional systems were reviewed. Systems considered were free radicals and chemical systems, oxygen-atom recombination ramjet, electrostatic propulsion, magnetogasdynamic propulsion, and various types of power plants. (W.D.M.)

4610 SCTM-136-56(51)

Sandia Corp., Albuquerque, N. Mex. EXPLICIT SYMMETRIC FLOWS OF HYDROMAGNETICS. O. G. Owens. June 28, 1956. 5p. OTS.

Results of investigation of two hydromagnetic problems are presented. The problems concern cylindrical and spherical hydromagnetic flows, respectively, and are shown to have explicit analytical solutions. (J.R.D.)

4611 SCTM-352-58(51)

Sandia Corp., Albuquerque, N. Mex. ATTRIBUTES SAMPLING PLANS FOR ASSURING HIGH LOT RELIABILITY. B. E. Barker. Dec. 19, 1958. 33p. Contract AT(29-1)-789. OTS.

A proposal is presented for situations in which a limited number of highly reliable items are needed, a specialized attributes acceptance sampling plan based on the hypergeometric distribution. Graphs are included to assist the reliability engineer to determine such plans for specific failure rates and degrees of confidence. (auth)

4612 UCRL-5707-T

California, Univ., Livermore. Lawrence Radiation Lab. PHYSICS OF THE ION THRUST SYSTEM. Raymond Fox. Oct. 7, 1959. 19p. Contract W-7405-eng-48. OTS.

Presented at the American Rocket Society, 14th Annual Meeting, November 16-20, 1959, Washington, D. C.

A study was made of the source, acceleration, and neutralization of ions for application to space propulsion. Some of the most important problems in this area and their solutions are summarized. (W.D.M.)

4613 WAPD-195

Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh. MONTE CARLO METHODS AND THEIR APPLICATION TO NEUTRON TRANSPORT PROBLEMS. J. Spanier. July 1959. 68p. Contract AT-11-1-GEN-14. OTS.

Application of Monte Carlo methods to neutron transport phenomena is considered. An attempt is made to present the theory as a rigorous mathematical discipline, using the language of probability theory and mathematical statistics.

No claim is made for either basic originality or completeness in the treatment. In the first part the mathematical foundations of the theory are established, and in the second part applications of the theory to neutron transport problems are discussed. (W.D.M.)

4614 AEC-tr-3855

CALCULATION OF THERMODYNAMIC FUNCTIONS FROM MOLECULAR DATA. Ivan Nicolaivich Godnev. Translated from a publication of the State Publishing House of Technical and Theoretical Literature, Moscow, 1956. 339p. OTS.

The elements of statistical thermodynamics and their application in calculating the thermodynamic functions of gases with a partial analysis for fluids and solids, as well as methods of calculating chemical equilibria and reactions of isotopic exchange are covered. In calculating these thermodynamic functions, the necessary molecular data including states and levels of energy are considered. The book is intended for senior upper-classmen in physico-chemical specialties, post-graduate students, engineers, and scientists interested in thermodynamics and its applications. (auth)

4615 AEC-tr-3911

SURFACE DETERMINATIONS AND DIFFUSION MEASUREMENTS BY MEANS OF RADIOACTIVE INERT GASES. (Practice and Quantitative Use of the Emanation Method). II. Evaluation of the Measurements. K. E. Zimens. Translated by Lydia Venters (Argonne National Lab.) from *Z. physik. Chem.* 191A, 95-128(1942). 31p. JCL.

The diffusibility (EV) is specified by the surface area of the preparation and by the magnitude of the diffusion constants in the diffusion of inert gases through a substance. Experimental methods are given which provide the possibility for successful determination of those two values and their dependence on the temperature, time, and preliminary treatment. (W.L.H.)

4616 AEC-tr-3921

ELECTROSTATIC ENERGY OF IONIC NETWORKS. F. Bertaut. Translated by Don T. Cromer and Gretchen R. Riese (Los Alamos Scientific Lab.) from *J. phys. radium* 13, 499-503(1952). 20p. JCL.

Very general expressions are derived for the energy and electrostatic potential of ionic networks whose use is illustrated by a practical example. The expressions of potential generalize those given by Ewald in 1921 and furnish a simple interpretation of them. (auth)

4617 NP-tr-321

ON THE FUNDAMENTAL LAW OF THE PHYSICAL EFFECTS OF X-RAYS OF VARYING WAVELENGTHS. [PART] II. R. Glocker. Translated by E. Franklin (U.K.A.E.A. Atomic Energy Research Establishment) from *Z. Physik* 136, 352-66(1953). 22p. (Figures omitted). JCL.

For long ranges of the resultant secondary electrons, the fundamental equation of the physical effects of x rays consists of three terms. The first comprises the electron energy produced in the volume considered, the second the part of this energy which does not remain in the volume, and the third the energy inflow due to electrons entering from outside. With simplifying assumptions, equations for the calculation of these three terms are derived and the results are confirmed by experimental observation of the wavelength dependence of ionization chambers and counters with various wall materials. (auth)

4618 NP-tr-322

THE P_N^* METHOD OF SOLVING THE NEUTRON TRANSPORT EQUATION. H. Koppe and G. Blüsser. Translated

by J. B. Sykes (U.K.A.E.A. Atomic Energy Research Establishment) from *Nukleonik* 1, No. 2, 64-6(1958). 11p. JCL.

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 12, as abstract No. 13380.

4619 SCL-T-287

THE CALCULATION OF THE EFFECTIVE REFLECTION AREA OF A SURFACE TARGET IN THE CENTIMETER WAVELENGTH RANGE. (K Voprosu o Raschëte Effektivnoy Ploshchadi Otrazheniya Poverkhnostnoy Tseli v Santimetrovom Diapazone Voln). G. I. Perov. Translated by Marcel I. Weinreich (Sandia Corp.) from *Radiotekhnika* 11, No. 7, 57-9(1956). 5p. JCL or LC.

An erroneous approach to the calculation of the effective reflection area along a surface which scatters the radio waves is discussed. It is shown that the formulas advanced in certain studies for the effective reflection area and for the directive gain of airplane antennas for panoramic radio locators must be further refined. (auth)

4620

ACCURACY OF BOND DISTANCES IN OBLIQUE COORDINATE SYSTEMS. David H. Templeton (Univ. of California, Berkeley). *Acta Cryst.* 12, 771-3(1959).

If $\sigma(x)$ is the standard deviation of an atomic coordinate, the standard deviation of position of that atom in the direction of the corresponding reciprocal axis is $\sigma(x) \cos \alpha\alpha^*$, where $\alpha\alpha^*$ is the angle between the direct and reciprocal axes. When this standard deviation is independent of direction, the statistical correlation coefficient of two coordinates of the atom is given by the cosine of the angle between the corresponding reciprocal axes. In the method of least squares, if the standard deviation of a coordinate is calculated with neglect of cross terms, it tends to be low by the factor $\cos \alpha\alpha^*$. It is shown that crystallographic independence does not imply statistical independence. (auth)

4621

DETERMINATION OF SPECIFIC ACTIVITY OF A FLUID FROM THE DOSE RATE MEASURED AT THE SURFACE OF CYLINDRICAL CONTAINERS OR PIPES. W. Kattwinkel (Kernenergieabteilung L. and C. Steinmüller GmbH, Gummersbach, Ger.). *Atomkernenergie* 4, 446-9(1959) Nov. (In German)

The specific γ -activity of fluids can be evaluated from the conveniently measurable dose rate at the surface of cylindrical containers or pipe-lines if the connection between specific activity and dose rate is known under given conditions. This connection is generally derived by means of buildup concept. The case of N^{16} ($E_0 = 6.2$ Mev) in water is treated in detail. (auth)

4622

GEOMETRICAL INTERPRETATION OF CONSERVATION LAWS IN THE SPINOR SPACE. J. Rzewuski (Wrocław Univ., Poland and Inst. of Physics, Wrocław Branch, Polish Academy of Sciences, Poland). *Bull. acad. polon. sci., Ser. sci., math., astron. et phys.* 7, 571-6(1959). (In English)

A geometrical interpretation of the conservation laws of angular momentum, isotopic spin, baryon number, charge, and hypercharge is given in the framework of spinor space. Some rules restricting the possible representations to those which correspond to observed particles are discussed. It is shown that, with certain natural assumptions, the spinor space is the only one which may be used for geometrical interpretation of the whole set of known conservation laws. (auth)

4623

IRREVERSIBLE PHENOMENA CAUSED BY ISOTOPIC SUBSTITUTION IN CRYSTALS. Cl. George (Université libre, Brussels). *Bull. classe sci., Acad. roy. Belg.* (5), 45, 239-50(1959). (In French)

A study is made of irreversible processes due to random isotopic substitution in solids. The classical Liouville equation is solved by means of the methods developed by Prigogine and his coworkers. By the use of two phonon diagrams, the irreversible long time equation in the weak coupling approximation is obtained. The behavior of a brownian phonon is treated in detail, and an approximate expression for its mean free path is derived. (auth)

4624

CIRCULATION OF THE MULTIPLE SCATTERING CONSTANT AND OF THE BACKGROUND NOISE IN THE CENTER OF GRAVITY METHOD. Brigitte Dépaux and Tsai-Chü. *Compt. rend.* 249, 2187-8(1959) Nov. 23. (In French)

In the measurement of multiple scattering, a track is divided into fundamental cells of equal lengths. To improve the precision of the measurements for short tracks Molière (*Z. Naturforsch.* 10a, 177(1955)) proposed the measurement of the deflection from the center of gravity of the grains of a small cell and taking the average of the deflection of two cells for a double cell. In the present work, the relationships between the second difference of the deflection, the multiple scattering, and background noise was established for the center of gravity method. (J.S.R.)

4625

CALCULATION OF THE BREMSSTRAHLUNG OF AN EXTREMELY RELATIVISTIC PARTICLE BY THE QUASI-REAL PROCESS METHOD. Paul Kessler. *Compt. rend.* 249, 2298-2300(1959) Nov. 30. (In French)

It is shown that the method of quasi-real processes makes it possible to relate the bremsstrahlung of an extremely relativistic fermion to the elastic scattering cross section. The result is identical to that obtained by an approximation calculation starting with the Bethe-Heitler formula for bremsstrahlung. (tr-auth)

4626

THE TEMPERATURE DEPENDENCE OF THE PHOTO-LUMINESCENCE OF SILVER-ACTIVATED CADMIUM ZINC SULFIDE. Ivan Soudek (Forschungsinstitut für Vakuumelektrotechnik, Prague). *Czechoslov. J. Phys.* 8, No. 1, 66-80(1958). (In German)

In the thermal extinction of the luminescence of sulfides, which are activated by silver and contain copper or nickel, in addition to the usual reversible process a second process with a hysteresis pattern of some importance occurs; moreover processes, which are connected with the photolytic blackening in a complicated dependence, are observed. The temperature dependence of the long-waved luminescence is distinguished in some samples from the dependence of the maximum of the spectral curve. A non-reversible increase of the long-waved luminescence was observed during heating. The relationship of the observed phenomena with the chemical composition of the luminescent substance was indicated. (tr-auth)

4627

MEASUREMENT OF THE VAPOUR PRESSURE OF SOME MACROMOLECULAR MATERIALS BY A RADIOMETRIC MANOMETER OF HIGH SENSITIVITY. Libor Pátý and Přemysl Schürer (Charles Univ., Prague). *Czechoslov. J. Phys.* 8, No. 1, 119-28(1958). (In Russian)

The possibility of using macromolecular materials in

vacuum systems was investigated initially by measurement of the vapor pressures of these materials. Measurements were made of the vapor pressure and its temperature dependence of seven samples of butylmethacrylate of varying molecular masses. The vacuum apparatus and its associated radiometric manometer used in the determinations and the measurement techniques are described in detail. The results show that butylmethacrylate, carefully cleaned of monomer, is a suitable material with respect to the vapor pressure for vacuum systems with pressures higher than 1×10^{-4} mm Hg as long as the operational temperature is not higher than 50°C . Some butylmethacrylate fractions have a vapor pressure low enough to be used in systems with pressures of the order of 10^{-5} mm Hg. (J.S.R.)

4628

THE EFFECT OF ELECTROMAGNETIC PROPERTIES OF THE SURROUNDING MEDIUM ON THE LONGITUDINAL PARAMETERS OF COAXIAL LINES. E. S. Kaplan (Kulbyshv Industrial Inst., USSR). *Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R.* 2, No. 6, 18-27(1959) June. (In Russian)

The skin effect is studied in an envelope of a coaxial line and in the surrounding medium. A general expression is found for the determination of the linear resistance of this line, taking into account the penetration of the envelope by the electromagnetic field. It is shown that in the case of certain problems related to low-frequency currents the material and dimensions of the metallic envelope have little effect on the longitudinal parameters of the line (r and x). The value of these parameters is determined mainly by the electromagnetic characteristics of the surrounding medium. (auth)

4629

ABSOLUTE MEASUREMENTS OF SOIL AND GROUND DENSITY BY THE GAMMASCOPIC METHOD. V. E. Nezerov (All-Union Scientific Research Fertilizer and Soil Science Inst., Moscow). *Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R.* 2, No. 6, 28-35(1959) June. (In Russian)

The use of the transmission gamma-beam method (gammascopic method) makes possible the prompt determination of soil density *in situ* without disturbing soil structure. When Geiger-Müller counters are used for detecting radiation, they must be calibrated, since variations in measurement and calibration conditions lead to errors. Using scintillation counters it is possible to exclude detection of scattered radiation; therefore the gammascopic method may be applied as an absolute method of soil density determination in field conditions. An experimental model of a portable scintillation device for gammascopic determinations was constructed. Field tests of the device show that density values determined gammascopically are in good agreement with those obtained by the standard method of cutting and weighing soil samples. (auth)

4630

HEAT CAPACITY C_p OF WATER AND WATER VAPOUR AT SUPERCRITICAL PRESSURES. A. E. Sheindlin, E. E. Shpil'rain, and V. V. Sychev (Inst. of Power Engineering, Moscow). *Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R.* 2, No. 7, 75-9(1959) July. (In Russian)

A method is described for analyzing experimental data on heat capacity C_p . With this method existing experimental data on heat capacity C_p of water and water vapor were analyzed and smoothed values of C_p found in the pressure interval 225 to 700 kg/cm² at 300 to 600°C, referring to selected values of temperature and pressure. (auth)

4631

THE EQUATION OF TEMPERATURE CHARACTERISTIC OF THE HALL ELEMENT IN Sb. I. F. Voloshin (Inst. of Power Engineering, Academy of Sciences, Belorussia SSR, Minsk). *Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R.* 2, No. 7, 100-1(1959) July. (In Russian)

The temperature characteristic of the Hall effect with an n -conductivity is expressed by an exponential equation whose constant coefficients can be determined from an experimental characteristic. (auth)

4632

THE ELECTRICAL CONDUCTIVITY OF DISPERSION MIXTURES OF CONDUCTORS WITH NON-CONDUCTORS. V. V. Skorokhod (Inst. of Metaloceramics and Special Alloys, Kiev). *Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R.* 2, No. 8, 51-8(1959) Aug. (In Russian)

A method is given for calculating the electrical conductivity of a dispersion mixture with a dielectric, at any concentration of the latter, by which the relationship between the relative conductivity of a mixture and the volume concentration of the insulator phase is found. The results of the calculation are in satisfactory agreement with experimental data obtained for sintered metallic porous bodies. (auth)

4633

THE MECHANISM OF EMISSION OF SUBSTANCE FROM ELECTRODES DURING ELECTRIC PULSE DISCHARGE. I. G. Nekrashevich and I. A. Bakuto (Inst. of Physics and Tech., Minsk). *Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R.* 2, No. 8, 59-65(1959) Aug. (In Russian)

With a single pulse discharge it is assumed that a dielectric current flows through sectors of a surface of an electrode 2 to 3 orders smaller than the observed spot on the face left by the discharge. Departing from the notion of the spontaneous transfer (migration) of an extremely narrow current-conducting channel on the surface of an electrode, the mechanism of emission of substance from electrodes during discharge is considered as a process consisting of a number of consecutive "micro-explosions" of small volumes of metal in the surface layer of the electrode, which are repeated many times in the course of a single current pulse. A formula is given which establishes the dependence of the quantity of emitted substance on the current in discharge and on the physical constant of the material of the electrode. An explanation is given of certain regularities observed in the destruction of the electrodes by an electrical pulse discharge. (auth)

4634

THE DISPERSION OF HEAVY POLYDISPERSE AEROSOL IN A TURBULENT ATMOSPHERE AT A LONG DISTANCE FROM AN INSTANTANEOUS POINT SOURCE. I. L. Karol' and A. Ya. Pressman (Inst. of Applied Geophysics, Moscow). *Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R.* 2, No. 9, 83-91(1959) Sept. (In Russian)

The qualitative and quantitative characteristics of the process of dispersion of polydisperse aerosols a long distance downwind of the source are discussed. The relationship between the expressions for volume concentration and surface concentration of polydisperse aerosols deposited from the atmosphere and boundary conditions on the surface of the earth is derived. Formulas for volume and surface concentrations are shown to be essentially different depending on whether or not the "weightless" component of polydisperse aerosols is reflected by the surface of the earth. (auth)

4635

TEMPERATURE EFFECTS ON THE SUPPLEMENTARY ABSORPTION SPECTRA IN SOME POLYACTIVATED PHOSPHORS. A. Kh. Khalilov and A. P. Medvedev. *Izvest. Akad. Nauk. Azerbaïdzhan. S.S.R., Ser. Fiz.-Tekh. i Khim. Nauk* No. 2, 37-9(1959). (In Azerbaïdzhani)

The temperature dependence of the supplementary absorption spectra in the NaCl + AgCl + TiCl and NaCl + AgCl + CuCl₂ phosphor monocrystals was investigated. It is shown that with a temperature rise the absorption intensity of the long wave region diminishes more rapidly than in the short wave region, a new line appears in NaCl + AgCl + TiCl, and with $\lambda_{\text{max}} = 255 \mu$ the line of NaCl + AgCl + CuCl becomes clearly outlined. (R.V.J.)

4636

EXCITATION AND ABSORPTION SPECTRA OF PHOSPHORS WITH VARIOUS ANIONS OF ACTIVATING ADMIXTURES. A. Kh. Khalilov and F. K. Isaev. *Izvest. Akad. Nauk Azerbaïdzhan. S.S.R., Ser. Fiz.-Mat. i Tekh. Nauk.* No. 3, 45-52(1959). (In Russian)

The main and supplementary absorption spectra and excitation spectra of visual and ultraviolet luminescence of phosphors (KCl + PbCl₂, KCl + PbBr₂, KCl + PbI₂, KBr + PbCl₂, KBr + PbBr₂, and KBr + PbI₂) containing various anions of activating Pb are investigated. The wave length of the maximum absorption bands and luminescence excitation bands are tabulated and spectral curves are plotted. It is shown that after x irradiation the intensity of absorption and excitation bands diminishes due to the reduced number of Pb²⁺ centers. (R.V.J.)

4637

ON THE PROPAGATION OF SHOCK WAVES IN A NON-HOMOGENEOUS ELASTIC MEDIUM. Eli Sternberg and J. G. Chakravorty (Brown Univ., Providence). *J. Appl. Mechanics* 26, 528-36(1959) Dec.

The propagation of shock waves in a nonhomogeneous isotropic plate of infinite extent and arbitrary thickness was studied. The plate has a transverse cylindrical hole at which uniform shearing tractions are suddenly applied and thereafter steadily maintained; the body is otherwise free from loading. It is assumed that the shear modulus of the material is proportional to an arbitrary—not necessarily integral—power of the radial distance from the axis of the hole, while no restriction is placed upon the (continuous) radial variation of Young's modulus. The solution obtained, which is discussed in detail, constitutes a generalization of results reached by Goodier and Jahsman, who considered the problem for a homogeneous medium. (auth)

4638

RARE EARTH COMPOUND SEMICONDUCTORS. J. F. Miller, F. J. Reid, and R. C. Himes (Battelle Memorial Inst., Columbus, Ohio). *J. Electrochem. Soc.* 106, 1043-6(1959) Dec.

Selenides of La, Er, and Y and tellurides of La, Er, Gd, and Y were prepared by direct reaction of the elements. Measured electrical characteristics indicate semiconducting behavior, with the possibility that a wide range of properties can be obtained within these series of rare earth compounds. Observed room-temperature resistivities, for example, ranged from about 10^{-4} ohm-cm for La₂Te₃ and ErSe to the insulator range for Y₂Se₃. All the compounds prepared possess high melting points (1400°-2000°C) and exhibit good thermal stability. The dissociation pressure of Gd₂Te₃ at its melting point appears to be as low as 0.01 atm. (auth)

4639

TRAJECTORIES INDEPENDENT OF MASS. J. Katz. *Bull. classe sci., Akad. roy. Belg.* (5), 45, 402-11(1959). (In French)

The explicit conditions required so that a force field does not separate particles of different masses are calculated. The expressions obtained are applied to gravity and stationary electromagnetic fields. (tr-auth)

4640

THE EFFECT OF INCLUSIONS ON THE ARCING BEHAVIOUR OF METALS. P. C. L. Pfeil and L. B. Griffiths (Atomic Energy Research Establishment, Harwell, Berks, Eng.). *J. Nuclear Materials* 1, 244-8(1959) Oct. (In English)

Metallographically prepared specimens of commercial and laboratory-made stainless steel and copper were made the negative electrode of a small spark gap in a low pressure hydrogen atmosphere, with the ultimate aim of predicting the suitability of these materials as components of thermo-nuclear apparatus. Microscopical examination, subsequent to sparking in the experimental tube, revealed that surface damage of the specimens had occurred around certain types of inclusion in the metals the remainder of the surface being unaffected. A correlation was established between the resistivity of inclusions and their effectiveness as arc-initiators. (auth)

4641

EXPERIMENTS ON MAGNETISM THROUGH NEUTRON SCATTERING. M. Ericson, P. G. De Gennes, A. Herpin, B. Jacrot, and P. Mériel (Centre d'Études Nucléaires, Saclay, France). *J. phys. radium* 19, 617-23(1958) July. (In French)

Two series of experiments are described on neutron scattering by magnetic media. Series A gives the antiferromagnetic structure of FeCl₂, and the effect of a magnetic field on the spin orientation as measured with a crystal spectrometer. In series B, the critical magnetic scattering of iron near the Curie point has been investigated with a time of flight spectrometer. As a result one gets both the range of the spin correlations and the scattering constant which is related to their decay in time. (auth)

4642

AN ITERATIVE METHOD IN NEUTRON TRANSPORT THEORY. W. R. Conkle (Atomic Energy of Canada, Chalk River, Ont.). *Nuclear Sci. and Eng.* 6, 267-71(1959) Oct.

An iterative method for solving problems in neutron transport theory is described. The method uses the result of a low-order spherical harmonics calculation as the initial function and attempts to improve this with one iteration. The results for the one-velocity Boltzmann equation with plane symmetry show that good accuracy is obtained for many practical cases. (auth)

4643

COMPLETE SPHERICAL HARMONICS SOLUTION OF THE BOLTZMANN EQUATION FOR NEUTRON TRANSPORT IN HOMOGENEOUS MEDIA WITH CYLINDRICAL GEOMETRY. Walter Kofink (Princeton Univ., N. J.). *Nuclear Sci. and Eng.* 6, 475-86(1959) Dec.

It is shown that the treatment of the transport equation in cylindrical geometry does not involve essentially more tedious calculations than the treatment in plane geometry. A complete solution is given for homogeneous media including the complementary solutions. Every partial solution contains in its expansion of spherical harmonics

some functions of a parameter with appropriate coefficients. It will be shown that these functions are Legendre polynomials and Legendre functions of the second kind as in the case of plane geometry for the "main" solution, and derivatives of these functions for the "complementary" solutions. They are solutions of the recursion relations for the expansion and yield a further recursion relation for the coefficients. Tables of these coefficients are given up to the eleventh spherical harmonic approximation and a general formula is derived for them. Two examples are worked out, a first based upon the supposition of a linearly anisotropic scattering law, and a second in which two higher terms of anisotropy are added to this law. (auth)

4644

A METHOD FOR THE MEASUREMENT OF THE NUCLEAR TRANSVERSAL RELAXATION TIME. G. Bonera, L. Chioldi, L. Giulotto, and G. Lanzi (Università, Pavia, Italy). *Nuovo cimento* (10) **14**, 119-34(1959) Oct. 1. (In English)

A method for measuring transverse relaxation times in liquids is described. The method is based on the observation of the decay of the nuclear magnetization when it precesses in a plane perpendicular to the constant magnetic field. This condition is realized by stopping the variation of the constant magnetic field during a fast adiabatic passage at a proper time. The constant magnetic field is modulated with a sawtooth current from a relaxation oscillator and an amplifier. When the voltage induced by the nuclear precession reaches a fixed value the relaxation oscillator is stopped with a delay such that the constant field stops its variation at the value for which the signal has the largest amplitude. Measurements were made on some pure liquids and the preliminary results indicate that the values of T_2 are very close to those of T_1 . (auth)

4645

INTERACTION BETWEEN ELECTRON BEAM AND MAGNET. S. Yamaguchi (Inst. of Physical and Chemical Research, Tokyo). *Nuovo cimento* (10) **14**, 248-9(1959) Oct. 1. (In English)

A singular interaction taking place between an electron beam and a magnet body is described. Utilizing an electron diffraction camera, photographs revealed that the incident beam was split into several beams which were semi-permanent or in a stationary state. (C.J.G.)

4646

ON THE LINE SHAPE IN AN ATOMIC BEAM. F. A. Korolev, B. A. Kozlov, and A. I. Odintsov. *Optics and Spectroscopy* (English Translation) **6**, 376-7(1959) May.

The influence of the evaporator slit width on the shape of the spectral line observed in an atomic beam was investigated theoretically. The general expression obtained for the distribution of intensity along the line contour includes earlier formulas as special cases. (auth)

4647

ELECTRO-LUMINOPHORS ON A SULPHIDE-SELENIDE BASE. O. N. Kazankin, F. M. Pekerman, and L. N. Petoshina. *Optics and Spectroscopy* (English Translation) **6**, 435-8(1959) May.

Electro-luminophors on a $\text{ZnS} \cdot \text{ZnSe}$ base, activated by Cu, were obtained in a static $\text{H}_2\text{S} + \text{HCl}$ atmosphere. This made it possible to get the hosts with greater ZnSe content, and thus, to prepare effective electro-luminophors with radiating capabilities in the long-wavelength region of the spectrum. Investigation of the dependence of the brightness of this type of electro-luminophors on the voltage, frequency, and temperature, revealed some peculiarities,

which are explained by the decreasing depth of the trapping levels as Se is added. (auth)

4648

DETERMINATION OF THE ABSOLUTE SENSITIVITY OF CERTAIN PHOTOGRAPHIC MATERIALS TO ULTRA-SOFT X-RADIATION. A. P. Lukirskii and I. A. Karpovich. *Optics and Spectroscopy* (English Translation) **6**, 444-6(1959) May.

The method used to obtain blackening curves of certain photographic emulsions under the action of ultra-soft x-radiation with wavelengths of 23.6, 44, 67, and 113 Å is described. An evaluation of the absolute sensitivity of the photographic materials studied is given. (auth)

4649

THE THEORY OF RESONANCE RADIATION OF A GAS DISCHARGE. B. A. Veklenko. *Optics and Spectroscopy* (English Translation) **6**, 459-60(1959) May.

A solution of the integral equation formulated by L. M. Biberman for the distribution of concentrations of excited atoms in the resonance emission of a gas discharge is given. An extremum functional is introduced into the solution similar to the functional introduced into transport theory by Marshak and Su Shu-Huang. (C.J.G.)

4650

INVESTIGATION OF LINEAR FLUORESCENCE AND ABSORPTION OF PURE CADMIUM SULFIDE CRYSTALS AT A TEMPERATURE OF 4.2°K. M. Bance-Grillot, E. F. Gross, E. Grillot, and B. S. Razbirin. *Optics and Spectroscopy* (English Translation) **6**, 461-2(1959) May.

An investigation of blue linear fluorescence at 4.2°K in samples of pure cadmium sulfide prepared by sublimation in a high temperature gradient was made more precise by using high dispersion spectral apparatus and was compared with results obtained in investigations of the absorption of light in the same crystals. The identical state of the fluorescence line polarization shows that they are all probably caused by the same system. (auth)

4651

INFLUENCE OF A MAGNETIC FIELD ON THE BLUE FLUORESCENCE LINES AND ON THE ABSORPTION LINES OF CERTAIN PURE CADMIUM SULFIDE CRYSTALS AT A TEMPERATURE OF 4.2°K. E. F. Gross, E. Grillot, B. P. Zakharchenia, and M. Bance-Grillot. *Optics and Spectroscopy* (English Translation) **6**, 462-3(1959) May.

Zeeman splitting into a doublet was detected in three fluorescence lines of cadmium sulfide crystals produced by sublimation in a high temperature gradient, at a temperature of 4.2°K in a magnetic field. This Zeeman splitting is not accompanied by a diamagnetic shift. (auth)

4652

SCREENING OF POINT SINGULARITIES IN METALS, WITH PARTICULAR REFERENCE TO POSITRON ANNIHILATION. B. Donovan (Bedford Coll., London). and N. H. March (The University, Sheffield, Eng.). *Phys. and Chem. Solids* **11**, Nos. 1-2, 68-72(1959) Sept.

The treatment of point singularities in metals, initiated by Mott, yields an infinitely large electronic density at a positive point charge, owing to the failure of the Thomas-Fermi approximation in this region. In the physically interesting problems involving positron annihilation, the positron lifetime depends on the electron density at the positron, and to obtain a useful result it is necessary to improve the statistical treatment. The modifications resulting from the introduction of von Weizsäcker's correc-

tion are discussed. In the high-density limit, an analytical development can be given that reveals the essential changes thus brought about. For real metallic densities, however, a laborious numerical calculation is necessary which is carried through for a unit positive charge embedded in an electron gas of density equal to that of the valence electrons in copper. The electron density at the point charge is eight or nine times the average electron density, indicating a positron lifetime of $(1.8 \pm 0.2) \times 10^{-10}$ sec. Comparison is made with the previous treatment of positron lifetimes by Daniel and Friedel. Brief reference is also made to the general subject of impurities and imperfections. (auth)

4653

NUCLEAR MAGNETIC RESONANCE STUDIES OF NEUTRON-IRRADIATED ALKALI HALIDES. J. F. Hon and P. J. Bray (Brown Univ., Providence). Phys. and Chem. Solids **11**, Nos. 1-2, 149-69(1959) Sept.

Nuclear magnetic resonance techniques were used to investigate radiation damage in some alkali halides. The resonances of Li^7 , Na^{23} , Br^{81} , and I^{127} , were studied to determine the concentration and arrangement of defects in neutron-irradiated single crystals of NaI, LiI, KI, and KBr. A method of analysis was developed, based on changes of line shape due to defect-induced quadrupolar effects. The experimental results are in fairly good agreement with theoretical predictions based, principally, on the methods of Seitz and Koehler and of Brinkman. Information was obtained on the strength of screening in coulomb potentials for atom-atom collisions and on the deformation of ion cores by charges external to the ions. Evidence for orientation of dislocations in preferred directions was noted in crystals of NaI and KI. (auth)

4654

DYNAMIC INSTABILITY OF ACCELERATED FLUIDS. C. T. Chang (Harvard Univ., Cambridge, Mass.). Phys. Fluids **2**, 656-67(1959) Nov.-Dec.

The asymmetrical growth of an interface separating two fluids of different densities, under the influence of an imposed acceleration (Rayleigh-Taylor instability), is shown to be mainly a nonlinear phenomenon. When the initial disturbance is a simple sinusoidal wave and is started from rest, it is found that the growth of the interface depends explicitly on two dimensionless parameters of the initial disturbance, the dimensionless amplitude (i.e., the amplitude-to-wave-length ratio) and the dimensionless wave number (i.e., the wave number of the initial disturbance to the "cutoff" wave number of the medium under the prevailing experimental condition). Results of the analysis show that the asymmetrical development of the interface occurs much earlier for disturbances of larger amplitudes and lower wave numbers than those of smaller amplitudes and higher wave numbers, i.e., those with wave numbers near the "cutoff." Surface tension shows a definite stabilizing effect. Because of the nonlinear effect, for a sinusoidal initial disturbance, a generation of higher harmonics as well as a feed-back to the fundamental is noted. Contrary to the prediction of the linearized theory, the present analysis, based on higher order approximations, reveals an "over-stable" phenomenon for disturbances having initial wave numbers beyond the "cutoff." (auth)

4655

PROPAGATION OF ELECTROMAGNETIC WAVES IN A MULTISTREAM MEDIUM AT GYROMAGNETIC RESONANCE. Jacob Neufeld (Oak Ridge National Lab., Tenn.). Phys. Rev. **116**, 19-20(1959) Oct. 1.

An electromagnetic wave traveling in a multistream medium in the direction of an applied magnetic field is described by the dispersion relation $c^2 k^2 = \omega^2 - \sum_i \omega_i^2 \omega / (\omega - k V_i \mp \Omega_i)$, where ω is the frequency, k is the wave vector, ω_i is the Langmuir frequency, Ω_i is the gyromagnetic frequency associated with the beam i , and V_i is the velocity of the beam i ($i = 1, 2, 3 \dots n$). For the case of gyromagnetic resonance ($\omega = \Omega_i$), growing and evanescent waves occur if $M = 27[\sum_i \omega_i^2 / V_i]^2 - 4\Omega_i^2 / c^4 > 0$, where $\Omega_i = \Omega_i$ for all i 's, and the occurrence of unattenuated waves if $M \leq 0$. (auth)

4656

PROOF OF THE LINKED-CLUSTER EXPANSION IN QUANTUM STATISTICAL MECHANICS. David J. Thouless (Univ. of California, Berkeley). Phys. Rev. **116**, 21-4 (1959) Oct. 1.

In order to go over from a perturbation expansion of the grand partition function (the unlinked-cluster expansion) to an expansion of the thermodynamic potential (the linked-cluster expansion) in powers of the interaction, it is necessary to treat carefully those terms in which creation (or annihilation) operators for the same state occur twice or more. The unlinked- and linked-cluster expansions for a system of fermions are here shown to be equivalent by a direct comparison of the terms which occur in each. The relation between the two expansions is illustrated by the example of a system of fermions interacting only with a single-particle potential. (auth)

4657

MANY-BODY PROBLEM IN QUANTUM STATISTICAL MECHANICS. II. VIRIAL EXPANSION FOR HARD SPHERE GAS. T. D. Lee (Columbia Univ., New York) and C. N. Yang (Institute for Advanced Study, Princeton, N. J.). Phys. Rev. **116**, 25-31(1959) Oct. 1.

The virial expansion method is used to evaluate the fugacity coefficients b_i to the order a^2/λ^2 for a hard-sphere gas with spin J satisfying Bose-Einstein or Fermi-Dirac statistics. (auth)

4658

ISOTOPE EFFECT IN THE BARDEEN-COOPER-SCHRIEFFER AND BOGOLIUBOV THEORIES OF SUPERCONDUCTIVITY. James C. Swihart (International Business Machines Corp., Poughkeepsie, N. Y.). Phys. Rev. **116**, 46-52(1959) Oct. 1.

It is shown that the Bardeen-Cooper-Schrieffer and Bogoliubov theories of superconductivity predict an isotope effect which is the same for all superconductors, so long as the Coulomb interaction is neglected. This is demonstrated by writing the system of integral equations in a mass-invariant form, and it does not involve finding actual solutions. The theories predict that H_0 , T_c , and the energy gap at $T = 0$ are proportional to $M^{-1/2}$. The inclusion of the Coulomb interaction destroys the invariance of the equations and introduces deviations from the $-1/2$ in the exponent. The magnitude of the deviation depends on the particular superconductor considered. (auth)

4659

N^{14} - N^{15} HYPERFINE ANOMALY. L. Wilmer Anderson, Francis M. Pipkin, and James C. Baird, Jr. (Harvard Univ., Cambridge, Mass.). Phys. Rev. **116**, 87-98(1959) Oct. 1.

The optical transmission of an optically oriented sodium vapor in spin-exchange equilibrium with atomic nitrogen was used to measure the zero-field hyperfine splitting of N^{14} and N^{15} . The ground state of atomic nitrogen is $^4S_{3/2}$. For N^{14} , which has $I = 1$, $\Delta\nu_{3/2 \rightarrow 1/2} = 26.12721 \pm 0.00018$ Mc/sec, $\Delta\nu_{3/2 \rightarrow 5/2} = 15.67646 \pm 0.00012$ Mc/sec. For N^{15} ,

which has $I = \frac{1}{2}$, $\Delta\nu = 29.29136 \pm 0.00016$ Mc/sec. The nuclear moments of N^{14} and N^{15} were remeasured by observing the effect of saturating the nitrogen resonance on the proton resonance in NH_4^+ . The results were $g(14)/g(H^1) = 0.07223695 \pm 0.00000008$, and $g(15)/g(H^1) = -0.10133093 \pm 0.00000008$. The N^{14} - N^{15} hyperfine anomaly obtained by combining these measurements is $\Delta = 0.000983 \pm 0.000017$. A short discussion of the mechanism of spin-exchange collisions is given. (auth)

4660

MULTIPOLE SINGULARITIES OF CLASSICAL VECTOR AND PSEUDOVECTOR FIELDS. Peter Havas (Lehigh Univ., Bethlehem, Penna.). *Phys. Rev.* **116**, 202-17(1959) Oct. 1.

The general form of the equations of motion of a particle possessing multipole singularities of a neutral vector or pseudovector meson field was found by Harish-Chandra under the assumption of a divergenceless current. In a recent paper a more general form of the interaction was proposed, and the equations of motion were found for this case for neutral, charged and charge-symmetric fields. In this paper forms were established of the multipole moments of arbitrary order compatible with these equations, and also of the moments compatible with the more restrictive interactions proposed by Harish-Chandra, which include those of electrodynamics as a special case; they are established under the assumption that the spin of the particle is of constant magnitude and has only spatial components in the rest system, and for pure 2^1 -pole moments of constant magnitude ("intrinsic moments") or of variable magnitude ("induced moments," acceleration-dependent forces). In the Appendix the results of a previous paper on singularities of scalar and pseudoscalar fields, which established the general form of the intrinsic moments, are generalized to show the possibility of induced moments of all orders, and it is shown that a particle can carry an arbitrary linear combination of multipole singularities of spin zero and one fields. (auth)

4661

RESONANT ABSORPTION OF THE 14.4-keV γ RAY FROM 0.10- μ sec Fe^{57} . R. V. Pound and G. A. Rebka, Jr. (Harvard Univ., Cambridge, Mass.). *Phys. Rev. Letters* **3**, 554-6 (1959) Dec. 15.

Resonant scattering of the recoil-free 14.4-keV γ ray of 0.10 μ sec Fe^{57} is reported. The resonance absorption is halved by a Doppler speed of $|\nu| = 0.017$ cm/sec which corresponds to 0.0009 cm peak-peak amplitude at 10 cps. There appear to be three satellite lines, the innermost occurring at a speed $|\nu| = 0.26$ cm/sec which corresponds to a frequency shift of 30.5 Mc/sec. If ground-state splitting is negligible, the three satellite lines would fall at Doppler frequencies equal to one, two, and three times the Larmor frequency of the spin $\frac{1}{2}$ excited state in the effective classical magnetic field at the nucleus in the ferromagnet. (C.J.G.)

4662

THE EQUATION OF STATE OF THE HYDROGEN ISOTOPES AND THEIR MIXTURES WITH HELIUM BELOW THE BOILING POINT OF HYDROGEN. F. H. Varekamp and J. J. M. Beenakker (Kamerlingh Onnes Laboratorium, Leiden). *Physica* **25**, 889-904(1959) Oct. (In English)

A method is described for measuring the temperature dependence of the second virial coefficient of the hydrogen isotopes relative to helium gas. The accuracy of this method is approximately a factor of ten higher than can be reached by standard (p, V) measurements. The results for H_2 , HD, and D_2 and their mixtures with helium are given as

a function of temperature below the boiling point of hydrogen. For numerical analysis empirical expressions for the data of the pure components are given. (auth)

4663

NOTE ON THE SOLUTION OF THE NEUTRON DIFFUSION PROBLEM BY AN IMPLICIT NUMERICAL METHOD.

George A. Baker, Jr. (Los Alamos Scientific Lab., N. Mex.). *Quart. Appl. Math.* **17**, 314-16(1959) Oct.

The numerical method of Baker and Oliphant for the solution of time-dependent heat-flow problems in rectangular regions is extended to obtain the solution of the time-independent neutron-diffusion equation for neutron density ϕ . Modifications are made so that it is not necessary to take Δt small. (C.J.G.)

4664

PHOTOMETRIC CHARGE MEASUREMENTS IN NUCLEAR EMULSION. Carlo Castagnoli, Massimiliano Ferro-Luzzi, and Guido Pizzella (Università, Rome and Istituto Nazionale di Fisica Nucleare, Rome). *Ricerca sci.* **29**, 2127-32 (1959) Oct. (In Italian)

By means of an automatized photometric device the ionization in nuclear emulsions of heavy ions accelerated to 10 Mev per nucleon was investigated. The best photometric parameter characterizing the charge of the ion was sought: this was found to be the impulse area, rather than the height or half width of the impulse. The impossibility of an accurate charge determination by the taper length method was proved. (auth)

4665

ON THE THEORETICAL DETERMINATION OF MAGNETIC SUSCEPTIBILITY IN LIGHT ATOMS. E. V. Manza, Ya. I. Vizbaraite, and A. P. Yutsis (Inst. of Physics and Mathematics, Academy of Sciences, of the Lithuanian SSR). *Trudy Akad. Nauk Litovskoi S.S.R., Ser. B.* No. 2 (18), 41-50(1959).

A precise method of calculation using the multi-configuration approximation, and the incomplete differentiation of variables, based on the two-electron model, is suggested for determining magnetic susceptibility. Numerical results obtained for atoms (ions) of the helium type, H^- to C^{4+} , and for beryllium type atoms, Li^- to C^{2+} , are demonstrated. (R.V.J.)

4666

SELF-CONSISTENT FOCK'S FIELD IN MULTI-CONFIGURATION APPROXIMATION FOR NEGATIVE POTASSIUM ION. T. D. Strotskite and A. P. Yutsis (Inst. of Physics and Mathematics, Academy of Sciences, Lithuanian SSR). *Trudy Akad. Nauk Litovskoi S.S.R., Ser. B.* No. 3(19), 3-8(1959). (In Russian)

The solution for Fock's equation was derived in multi-configuration approximation for radial wave functions $4p$ and $3d$, as corrective configurations for approximations of $4s^2 - 4p^2$ and $4s^2 - 3d^2$, for the negative potassium ion. The magnitude of shell energy $4s^2$ in the tri-configuration approximation $4s^2 - 4p^2 - 3d^2$ was determined, and the magnitude of electron affinity to the potassium ion was found. (R.V.J.)

4667

NUCLEAR QUADRUPOLE RESONANCE. V. S. Grechishkin. *Uspekhi Fiz. Nauk* **69**, 189-216(1959) Oct. (In Russian)

A systemized review is given of the accumulated data and the investigations now in progress in USSR in the field of nuclear quadrupole resonance. 180 references. (R.V.J.)

4668

PROPERTY MEASUREMENTS AT HIGH TEMPERATURES. FACTORS AFFECTING AND METHODS OF MEASURING MATERIAL PROPERTIES AT TEMPERATURES ABOVE 1400°C (2550°F). W. D. Kingery. 424p. New York, John Wiley & Sons, Inc., 1959.

Various methods and instruments employed for property measurements at high temperatures (above 1400°C) are described. The factors that affect results in different kinds of measurements as well as the measurement techniques most suitable for particular systems and temperature ranges are discussed. Various properties and applications of laboratory refractories and designs of laboratory furnaces are given. Applications of the property measurements in research are discussed. (C.J.G.)

4669

DÉVELOPPEMENTS THÉORIQUES RÉCENTS EN SPECTROSCOPIE NUCLÉAIRE. (Recent Theoretical Developments in Nuclear Spectroscopy). Monographie No. 5. M. Demeur. Brussels, Institut Interuniversitaire des Sciences Nucleaires, 1959. 64p. (In French)

The contents of a cycle of conferences held April 1959 by the Institut Interuniversitaire des Sciences Nucleaires are presented. Recent experimental data are given on rotation bands and vibration spectra. The other sections given include: gamma-unstable model, beta and gamma vibrations, octupolar vibrations, intrinsic states moment of inertia, the correlated pair model, bond between individual and collective properties, fission and low-energy spectra, and monokinetic positron emission. (T.R.H.)

4670

PREMIER COLLOQUE INTERNATIONAL DE PHOTOGRAPHIE CORPUSCULAIRE, STRASBOURG, 1^{er} AU 6 JUILLET, 1957. (First International Colloquium on Particle Photography, Strasbourg, 1-6 July, 1957). Paris, Centre National de la Recherche Scientifique, 1958. 451p.

The First International Colloquium on Particle Photography, was held at Strasbourg, July 1 to 6, 1957, under the auspices of the International Colloquia of the Centre National de la Recherche Scientifique. The object of the meeting was two-fold: assembly of knowledge on the mechanism of photographic action of charged particles and presentation of recent research results. Separate abstracts have been prepared for each of 47 papers presented. (T.R.H.)

4671

PHOTOGRAPHIC SENSITIVITY. John W. Mitchell (Univ. of Bristol, Eng.) p.13-44 of "First International Colloquium on Particle Photography." (In French)

The mechanism of photolysis and studies on latent images are discussed preliminary to description of methods of preparation and chemical sensitization of photographic emulsions. Also described are: physical properties of Ag halide crystals, theory of formation of latent images, and chemical development. The theory of photography offered involves a sensitivity-center concept. (T.R.H.)

4672

SULFIDE SENSITIZATION OF SILVER BROMIDE EMULSIONS. A. Hautot (Université, Liège). p.44-53 of "First International Colloquium on Particle Photography." (In French)

Sulfide sensitization occurs by formation of particles at the surface of AgBr crystals corresponding to the first colloidal state. Active centers result depending on conditions. The creation of these active centers is accom-

panied by other disturbances at the grain surface which are responsible for the diversity of properties of these emulsions. Experimental results lead to a three-part mechanism for sulfide sensitization. (T.R.H.)

4673

EFFECTS OF ELECTRONS ON PHOTOGRAPHIC FILM. Hellmut Frieser. p.55-69 of "First International Colloquium on Particle Photography." (In French)

Two sets of experiments are reported; one involves an experimental emulsion under various conditions, the other involving different commercial emulsions. It was found that the density increased in proportion to radiation received up to a limit. Electron sensitivity is greater for thicker emulsions and for higher AgBr concentrations. The limit is reached when emulsion thickness approaches the electron mean free path. (T.R.H.)

4674

THE SINGLE AND THE COLLECTIVE METHOD IN X-RAY PHOTOGRAPHY. M. H. Tellez-Plasencia (Centre National de la Recherche Scientifique, Paris). p.71-83 of "First International Colloquium on Particle Photography." (In French)

Particle photography research is essentially concerned with single individual events, but the collective method, using statistical techniques on large numbers of events, is also of value. Studies are described and discussed in which both methods were involved. The investigation was attacked from two directions: the quantal, in which the probability of a grain being developed after absorbing a certain number of quanta have been absorbed is considered, and the energetic, which involves the balance of energy absorbed and utilized to obtain a certain density. (T.R.H.)

4675

EFFECTS OF S^{2-} IONS ON VARIATION IN RECIPROCITY OF THE SURFACE IMAGE AT VERY SHORT EXPOSURE TIMES. Henri Sauvenier (Université, Liège). p.85-92 of "First International Colloquium on Particle Photography." (In French)

Studies are described which were undertaken to resolve the question of whether reciprocity variation at high degrees of clarity are a property of bromide emulsions or are they produced also in AgBr emulsions. Four types of emulsions were used: AgBr emulsion with active and inactive gelatin, AgBr suspensions dispersed in inactive gelatin, and AgBr-5% AgI emulsions in inactive gelatin. Various chemical sensitizers were used. The reciprocity variation in the surface image was measured over the range of exposures from 10^{-6} to 10^5 sec. (T.R.H.)

4676

FORMATION OF A LATENT IMAGE BY NUCLEAR PARTICLES. W. F. Berg (Kodak Ltd., Harrow, Eng.). p.93-8 of "First International Colloquium on Particle Photography." (In French)

Problems in latent image formation by nuclear particles are briefly reviewed. (T.R.H.)

4677

WORK ON NUCLEAR EMULSIONS AT THE UNIVERSITY OF MONTREAL. Pierre Demers (Université, Montreal, Can.). p.99-105 of "First International Colloquium on Particle Photography." (In French)

Techniques and formulas for multiple-cast emulsion preparation are described, and regression is discussed. (T.R.H.)

4678

A COMPARATIVE PROCESS FOR MEASUREMENT OF THE SENSITIVITY OF PHOTOGRAPHIC NUCLEAR

EMULSIONS. Inz. W. Markocki (Politechn, Wroclaw, Poland). p.107-13 of "First International Colloquium on Particle Photography." (In French)

A method for sensitivity determination of nuclear emulsions is described which depends on measuring the darkening of an emulsion, developed but not fixed or dried, in reflected light. (T.R.H.)

4679

LACK OF RECIPROCITY OF THE PRINCIPAL NUCLEAR EMULSIONS. THEIR INTERPRETATION ACCORDING TO THE VARIABLE DISPERSION HYPOTHESIS.

R. Schmitt and F. Simon (Université, Strasbourg). p.115-23 of "First International Colloquium on Particle Photography." (In French)

Different commercial emulsions (Ilford G5, E1, D1, and C2, Kodak NT2 and NT4) were studied as to their response to exposures to light ranging from 28 min to 10^{-6} sec. Curves of density versus exposure time were obtained for each emulsion for both ID-19 and pyrocatechine development. These curves and others derived from them are analyzed and discussed along with γ -values. (T.R.H.)

4680

THE LATENT IMAGE AT LOW TEMPERATURE IN NUCLEAR EMULSIONS. M. Debeauvais-Wack (Université, Strasbourg). p.125-30 of "First International Colloquium on Particle Photography." (In French)

The effects of exposure of Ilford G5 and C2 at liquid N_2 temperatures were studied. The emulsions were supported on cellulose acetate to avoid crackling and other effects which occur with glass. Exposures to α , β , and γ radiation and light were made. The low temperature inhibits ionic phenomena making possible a verification of the Cier hypothesis concerning latent images. (T.R.H.)

4681

THE HERSHEY EFFECT AND FADING IN NUCLEAR EMULSIONS. M. W. Meier and K. Lanius. p.131-2 of "First International Colloquium on Particle Photography." (In French)

A study was made of fading and latent image transformation in electron tracks due to γ rays for different red post-illumination times using Agfa K₂ emulsion. The curves suggest an hypothesis involving shape and distribution of seed crystals in AgBr grains. It is shown that red sensitivity and latent image stability as functions of fading and the Hershey effect vary widely among emulsions from different melts. (T.R.H.)

4682

PREPARATION OF NUCLEAR PHOTOGRAPHIC EMULSIONS FOR RECORDING PARTICLE TRACKS AT MINIMUM IONIZATION. C. S. Bogomolov, A. A. Sirotinskaya, M. U. Deberdiyev, and V. M. Ovarova (Institut NIKFI, Moscow). p.133-44 of "First International Colloquium on Particle Photography." (In French)

The theoretical basis homogeneity principle for preparation of fine-grain photographic emulsions of high sensitivity is presented and applied. Other topics covered are: factors determining the degree of homogeneity of dispersion, granulometric homogeneity of photographic emulsions, first aging, separation of the solid phase, dispersion, sensitization and second aging, and properties of R-type emulsions. (T.R.H.)

4683

AN IONOGRAPHIC EMULSION WITH POLYVINYL ALCOHOL. Pierre Demers and André K. Schwerin (Université, Montreal, Can.). p.145-8 of "First International Colloquium on Particle Photography." (In French)

Experience with emulsions in which polyvinyl alcohol (PVA) replaces gelatin is reported. The PVA is synthetic and its properties reproducible from batch to batch. Protection of the colloid during precipitation is a problem. Melting of the gel after washing is difficult, and it remains sticky. (T.R.H.)

4684

NEW EMULSIONS FOR RECORDING X OR γ RADIATION OR PARTICLES. Jacques M. Blum. p.149-57 of "First International Colloquium on Particle Photography." (In French)

Two new types of emulsions are described which record ionizing particles or x or γ rays by arbitrary colors. The color thus represents a variation of wavelength or ionizing power. Principle of the emulsion and some experiments with it are discussed, but preparation is not. It is concluded that this finding represents the basis for a new method which will render available certain knowledge previously unavailable. (T.R.H.)

4685

PREPARATION OF PURE SILVER CHLORIDE NUCLEAR EMULSIONS AND THEIR PROPERTIES. H. Gauvin and W. Sebaoun (Institut du Radium, Laboratoire Curie, Paris). p.158-67 of "First International Colloquium on Particle Photography." (In French)

A technique for preparing pure AgCl emulsions is described, and the effects of pAg and pH on precipitation (clouding, microcrystal size, and sensitivity) and on the sensitivity of remelted emulsion before pouring were studied. Experiments on discrimination of x particles and protons were also carried out. These studies determined the conditions in which useful emulsions could be prepared, and revealed the value of pure AgCl emulsions in nuclear physics. By controlling sensitivity through pAg, pH, and chemical sensitizers the emulsion can be adapted to various studies. (T.R.H.)

4686

STUDY OF DEMERS-TYPE EMULSIONS. Albert Oliver (Univ. of California, Livermore). p.169-72 of "First International Colloquium on Particle Photography." (In French)

The work of P. Demers on electron-sensitive emulsions is discussed. Pictures and graphs are presented which depict the apparatus used for preparation of emulsions and minimum ionization tracks in Demers emulsion, and give data on: number of masses for a triple-cast emulsion versus age and quantity of sensitizer, sensitizer quantity versus age, and number of masses versus sensitizer quantity. (T.R.H.)

4687

COMPARISON OF CERTAIN METHODS OF INCREASING THE DISCRIMINATING POWER OF NUCLEAR EMULSIONS. C. S. Bogomolov and A. A. Sirotinskaya (Institut NIKFI, Moscow). p.173-81 of "First International Colloquium on Particle Photography." (In French)

A comparison is presented of a series of methods for increasing the discrimination of emulsions, and the applications of the results are pointed out. The methods included are based on: variation of emulsion properties, latent image effects, and special development processes. (T.R.H.)

4688

SPECIFIC MASS AND COMPOSITION OF ILFORD G-5 NUCLEAR EMULSIONS. A. J. Swinnerton and C. Waller. p.183-94 of "First International Colloquium on Particle Photography." (In French)

The specific mass and percentage composition of Ilford G-5 emulsion in equilibrium with an atmosphere of 58% relative humidity were determined. Methyl salicylate was used as a reference liquid. The effects of relative humidity on the determination were studied, and analogous indications for other nuclear emulsions of the same origin were pointed out. (T.R.H.)

4689

REGRESSION OF THE LATENT IMAGE OF TRACKS OF WEAKLY IONIZING PARTICLES. C. S. Bogomolov and K. M. Romanovskaya (Institut NIKFI, Moscow). p.195-201 of "First International Colloquium on Particle Photography." (In French)

The relation between latent image regression and particle energy was studied. The method used consisted of irradiating stacks of type R emulsion by a pion beam of 180 to 220 Mev. Density measurements were made from tracks of scattered mesons which terminated in the emulsion. A normal stack and an experimental stack of 400- μ emulsion layers were irradiated after drying 7 to 10 hours at 20°C and 58% relative humidity. The results are presented and interpreted theoretically. (T.R.H.)

4690

THE PHOTOGRAPHIC EFFECT OF CHARGED PARTICLES AT LOW TEMPERATURES. K. S. Bogomolov, I. F. Rasorenova, and A. A. Sirotinskaya (Institut NIKFI, Moscow). p.203-11 of "First International Colloquium on Particle Photography." (In French)

The study of nuclear interactions at liquid H and He temperatures requires a knowledge of particle photography at very low temperatures. An investigation of the decrease of sensitivity of emulsions at low temperatures is described. X irradiation followed by conditioning at low temperature showed no effect on sensitivity. It was also found that residual sensitivity at low temperature is practically independent of the absolute value of type R emulsion sensitivity. Other experiments are described which reveal information about the mechanism of photographic processes at low temperatures. (T.R.H.)

4691

QUANTITATIVE RELATIONS FOR PHOTOGRAPHIC ACTION OF WEAKLY IONIZING CHARGED PARTICLES. C. S. Bogomolov (Institut NIKFI, Moscow). p.213-31 of "First International Colloquium on Particle Photography." (In French)

A theoretical study is presented which establishes quantitative relations between grain density in charged particle tracks and the ionizing power of the particles as a function of the principle parameters of the emulsion layer. (T.R.H.)

4692

SOME METHODOLOGICAL PROBLEMS OF INTEREST AT HIGH AND VERY HIGH ENERGIES FOR INVESTIGATION OF PROCESSES BY THE EMULSION STRIPPING TECHNIQUE. G. B. Zhdanov (Lebedev Inst. of Physics, Moscow). p.233-9 of "First International Colloquium on Particle Photography." (In French)

The problems involved in the use of the emulsion stripping technique in nuclear research are discussed. (T.R.H.)

4693

WHAT USERS EXPECT OF EMULSION MANUFACTURERS. Occhialini (Université, Brussels and Université, Milan). p.241-6 of "First International Colloquium on Particle Photography." (In French)

The text of this paper was not available, however a chart with emulsion defects arranged versus causes and remedies is presented and discussed. (T.R.H.)

4694

AN IMPROVED ISOTHERMAL METHOD FOR THE TREATMENT OF THICK PELLICULES OF NUCLEAR EMULSIONS. H. Yagoda (National Institutes of Health, Bethesda, Md.). p.247-54 of "First International Colloquium on Particle Photography." (In French)

Uniform development of thick emulsions of 1500 μ is accomplished by developing the emulsion without support between two thick sheets of absorbent paper which give the solutions access to the two faces. The absence of a hot phase reduces track distortion. One develops minimum ionization tracks at a grain density of 15 ± 4 grains/100 μ , the particular number depending on the age, sensitivity of base and exposure temperature of the portion of emulsion. A high degree of uniformity in deep development is obtained by use of a series of compensator baths the developing power of which is controlled by pH. Simplifications are described for a previous process which reduce the time and effort required for drying and clarifying. A protective layer of glass serves as a cover glass and facilitates observation of the total depth of emulsion with oil immersion objectives of large aperture. (tr-auth)

4695

DEVELOPMENT TANNING OF NUCLEAR EMULSIONS. Joseph Kubal (Fysikální Instav Karlovy Univ., Prague). p.255-7 of "First International Colloquium on Particle Photography." (In French)

Tanning to reduce distortion during later treatment of emulsions is discussed. Alkaline developers such as pyrocatechine, metal, hydroquinone, and paraphenylenediamine exert a tanning effect on gelatin for low sulfite concentrations (>2 to 5 g/l). Three processes using pyrocatechine are described which give good results for α particles and protons up to 15 Mev for 200 μ thicknesses. (T.R.H.)

4696

A FIXATION PROCESS WHICH AVOIDS CORROSION. M. Paic, G. Thuro, and M. Turk-Zivkovic (Institut "Ruder Boskovic," Zagreb). p.259-72 of "First International Colloquium on Particle Photography." (In French)

Experiments were performed on photographic plates which indicated that corrosion or dissolution of Ag in the fixer was due to atmospheric oxidation. If degassed water is used for fixer preparation, the corrosion can be prevented by addition of reducers to the fixer. These results were extended to nuclear emulsions and formulas for fixer preparation to prevent their corrosion were found and tested. (T.R.H.)

4697

DEFICIENCIES IN DEVELOPMENT WITH AN AMIDOL DEVELOPER. EFFECTS OF SODIUM SULFITE, TEMPERATURE, AND TIME OF DEVELOPMENT. G. D. Fatser, R. Weill, M. Gailloud, and Ch. Haenny. p.273-7 of "First International Colloquium on Particle Photography." (In French)

The optimum conditions of time, temperature, and Na_2SO_3 concentration for bithermal development with amidol were determined using Ilford G-5 and three different formulas between 5 and 25°C. It was found that increasing the Na_2SO_3 concentration in amidol developer and selecting a high enough drying temperature will eliminate errors but contrast decreases. This situation can be compromised by developing at low temperature with Na_2SO_3 concentration sufficient to prevent coloration of the emulsion and disappearance of the image. The best conditions are determined for each batch. (T.R.H.)

4698

THE PROBLEM OF TREATMENT OF ANY VOLUME OF NUCLEAR EMULSION. George Marquin (Université,

Lyon). p.279-89 of "First International Colloquium on Particle Photography." (In French)

One solution to the problem was obtained by stacking 1-mm emulsions unsupported by glass, in plastic frames super posing them during exposure. During treatment the emulsions on their frames are placed on stainless steel holders to prevent deformation. They are subjected to a bilateral development process, isothermal at a low temperature, based on a progressive variation of the pH of solutions. This method produces emulsions uniformly developed in depth, very little distortion, and final dimensions equal to the original dimensions. (tr-auth)

4699

THE PROBLEM OF THE RANGE-ENERGY RELATION IN NUCLEAR EMULSIONS. Walter H. Barkas (Univ. of California, Berkeley). p.291-3 of "First International Colloquium on Particle Photography." (In French)

A range-energy relation table is presented for a standard-density emulsion of 3.815 g/cm^3 . Fourteen empirical points were determined for protons of equivalent energy 1 and 700 Mev. The Bethe and Bloch stopping-power theory was used for comparison and correction. (T.R.H.)

4700

DISCRIMINATION OF TRACKS BY TRANSVERSAL MEASUREMENTS. J. P. Lonchamp and Ch. Gegauff (Université, Strasbourg). p.297-303 of "First International Colloquium on Particle Photography." (In French)

A review is presented on the use of transversal measurements of particle tracks, and results of studies of fluctuations in projective areas of tracks are given and discussed. (T.R.H.)

4701

IDENTIFICATION OF PARTICLES IN FINE GRAIN EMULSIONS. Ishfaq Ahmad, Pierre Demers, and Jean-Louis Meunier (Université, Montreal, Can.). p.305-28 of "First International Colloquium on Particle Photography." (In French)

The procedures for preparing a fine-grain emulsion and analyzing it after exposure are described. The conditions for analysis and the precision of the information obtained are discussed. The fine-grain emulsion was a double-poured one which indicated minimum ionization tracks at $13.6 \text{ grains/100}\mu$. (T.R.H.)

4702

γ -PARTICLE DISCRIMINATION USING A POTASSIUM FERROXALATE DEVELOPER. H. Braun (Laboratoire de Physique Corpusculaire, Strasbourg). p.329-32 of "First International Colloquium on Particle Photography." (In French)

Previous developers for γ discrimination lack stability and reproducibility of results. A developing solution was developed which overcame these disadvantages. The three stock solutions are: A-15g citric acid, 250g $\text{K}_2\text{C}_2\text{O}_4$, 5g $\text{Fe}_2(\text{SO}_4)_3$ in 1 l distilled H_2O ; B-5g citric acid, 250g $\text{K}_2\text{C}_2\text{O}_4$, 5g $\text{Fe}_2(\text{SO}_4)_3$ in 1 l distilled H_2O ; C-119g KBr in 1 l distilled H_2O . For γ - α discrimination the following method is recommended: impregnation with 5.4 cc 1N KBr in 100 cc dist H_2O 5 min at 10° , development with 100 cc soln A, 3.5 cc soln B, and 5.4 cc soln C 60 min at 10° , wash in running H_2O , fix. (T.R.H.)

4703

GRAIN DENSITY ALONG TRACKS IN PHOTOGRAPHIC PARTICLE EMULSIONS. J. P. Bailliard (Université,

Strasbourg). p.333-44 of "First International Colloquium on Particle Photography." (In French)

A grain density theory is discussed in the light of recent latent image theory. A theory is presented which explains satisfactorily the principle aspects of granulation under the effects of charged particles. Experiments to verify the theory are described. (T.R.H.)

4704

MIXTURES OF NUCLEAR EMULSIONS. M. Rene and G. Vanderhaeghe (Université, Brussels). p.345-8 of "First International Colloquium on Particle Photography." (In French)

Experiments to develop a single emulsion which allows simultaneous particle discrimination and fast particle observation are described. A 50-50 mixture of Ilford G5 and G0 was compared with pure G5 and pure G0. The experiments show that, as a first approximation, the mixture retains effectively the properties of the pure emulsions. One difficulty encountered was that of obtaining a sufficiently homogeneous mixture. (T.R.H.)

4705

PHOTOMETRIC ANALYSIS OF TRACKS IN NUCLEAR EMULSIONS WITH A VIEW TO DISCRIMINATION. P. G. Bizzeti, M. Della Corte (Università, Firenze, Italy). p.349-55 of "First International Colloquium on Particle Photography." (In French)

A photometric method for study of nuclear emulsions is described which is based on measurement of the size at half-height of the transversal profile of darkening. The microscope used was a modified MS2. In place of the ocular there was a divergent lens and then two mirrors. In the image plane there was a slit parallel to the track and behind the window a photomultiplier, the signal of which is amplified and sent to the vertical plates of an oscillograph. The first mirror is fixed to a small coil supported by a bifilar suspension between the poles of a magnet. A sinusoidal alternating current in the coil causes it to oscillate around an axis perpendicular to the plane of the magnet so that the image sweeps the plane of the slit. The same current is amplified and rephased and sent to the horizontal plates of the oscillograph to produce the average darkening profile on the screen. The method can be used for charge determination, is simple and fast, and is independent of illumination intensity and track depth in the emulsion. (T.R.H.)

4706

USE OF NUCLEAR EMULSIONS FOR NEUTRON SPECTROMETRY. Louis Rosen (Los Alamos Scientific Lab., N. Mex.). p.357-8 of "First International Colloquium on Particle Photography." (In French)

The two methods of neutron spectrometry using nuclear emulsions are described in principle. In one, the emulsion is a proton or deuteron detector, in the other, the emulsion is both target and detector. (T.R.H.)

4707

POSSIBILITIES OF NUCLEAR EMULSIONS IN SPECTRAL ANALYSIS OF REACTOR NEUTRONS. C. Beets (Centre d'Études pour les Applications de l'Énergie Nucléaire, Brussels). p.359-70 of "First International Colloquium on Particle Photography." (In French)

A theoretical treatment of reactor neutron spectroscopy using emulsions is given. The analysis reveals the limitations and advantages of the methods. (T.R.H.)

4708

THE PRECISION OF ANGULAR MEASUREMENTS IN NU-

CLEAR EMULSIONS. W. M. Gibson and J. G. McEwen (The Queen's University, Belfast). p.371-3 of "First International Colloquium on Particle Photography." (In French)

The precision of angle measurement in nuclear emulsions is limited by: useful length, microscope quality, distortion, and non-uniform contraction. The latter was studied experimentally, and it was found that the effect is more pronounced near the surface. A correction is necessary depending on the processing method used. (T.R.H.)

4709

VARIATIONS IN CLOUDING OF NUCLEAR EMULSIONS WITH pH OF THE DEVELOPER IN THE COLD. J. Bermond and M. Scherer (Faculté des Sciences, Caen, France). p.375-83 of "First International Colloquium on Particle Photography." (In French)

The effects were studied of pH of Amidol developer on clouding density at different depths in 400- μ Ilford G5 emulsions treated 80, 90, 100, and 120 min at 5°C. The developers of the pH 6 to 6.4 group gave best results for clouding density uniformity in depth while retaining sufficient activity. The technique of development with reheating is not useful at more than 90 min in the cold for the 400 μ emulsion. A longer time at this stage causes over development where the developer is more active. (T.R.H.)

4710

MEASUREMENT OF NEUTRON FLUX BY A NUCLEAR EMULSION GEL. M. Juric, D. Winterhalter, and M. Dordevic (Institut de Sciences Nucleaires "Boris Kidrich," Belgrad). p.385-90 of "First International Colloquium on Particle Photography." (In French)

Emulsions loaded with B¹⁰, Li⁶, N¹⁴, and U²³⁵, for neutron flux measurement, were studied. The method of preparation involved putting gel-form Ilford emulsion into solutions of known weight and concentration; the dried emulsion thus contained a known amount of the substance added. Measurements with B¹⁰- and U²³⁵-loaded emulsions are reported. (T.R.H.)

4711

THE "CONSTANT DEFLECTION" METHOD FOR PROTONS OF LESS THAN 2000 μ RANGE IN AN EMULSION. J. Catala, F. Senent, and J. Aguilar (Université, Valence, France). p.391-400 of "First International Colloquium on Particle Photography." (In French)

The constant deflection method was used to measure 39 short-path proton tracks at the end. The value of D was calculated eliminating background noise between a basic cell arrangement and a multiple cell arrangement. The results agree with those obtained for long-path protons. (tr-auth)

4712

PROPERTIES AND USE OF DILUTE NUCLEAR EMULSIONS. Georges Philbert and Marietta Heschnonle (College de France, Paris). p.401-8 of "First International Colloquium on Particle Photography." (In French)

Experiments with Ilford G5 emulsions diluted 2 and 4 times are described. Treatment was similar to that for normal emulsions. Scattering, ionization, and observability of phenomena are discussed. (T.R.H.)

4713

SOME EXAMPLES OF THE USE OF AUTORADIOGRAPHY IN METALLURGY. H. Faraggi (Centre d'Études Nucleaires, Saclay, France). p.409-16 of "First International Colloquium on Particle Photography." (In French)

The general areas of metallurgy in which autoradiographic techniques are of use are pointed out and discussed. Mostly the very primitive darkening and contact methods are used. Applications and limitations of both techniques are discussed. (T.R.H.)

4714

THE TRACE-HISTOPHOTOGRAPHIC METHOD. R. Rechenmann (Université, Strasbourg). p.417-19 of "First International Colloquium on Particle Photography." (In French)

The pouring, drying, exposure, development, coloration, and observation of emulsions in contact autoradiography are described, and applications of the technique in biology are discussed. (T.R.H.)

4715

MEDICAL APPLICATIONS OF THE TRACE-HISTOPHOTOGRAPHIC METHOD. C. M. Gros (Faculte de Medecine, Strasbourg) and C. Gegauff (Université, Strasbourg). p.419-21 of "First International Colloquium on Particle Photography." (In French)

Trace-histophotography was used in studies of Th distribution, radiogold distribution in auxiliary ganglions, and effects of thyroid grafts on testicles. (T.R.H.)

4716

EMULSION CASSETTES FOR STUDY OF COSMIC RAYS BY HIGH-ALTITUDE ROCKETS. H. Yagoda (U. S. Dept. of Health, Bethesda, Md.). p.423-32 of "First International Colloquium on Particle Photography." (In French)

A study is presented of the exposure of nuclear emulsions to cosmic radiation above the atmosphere using high-altitude probe rockets. A protective cassette design is described which introduces a vertical absorbing mass of 270 mg/cm² on the upper face which gives data for terminal impact velocities less than 300 mph. When the instrument section is detached with its parachute and when the nose-cone of the rocket has been propelled above the atmosphere, the exposures to cosmic radiation and micro-meteorites can be carried out with a minimum of absorbing mass ≤ 200 mg/cm² at all angles. For 22 exposures over a period of 8 years the instrument section was recovered 14 times. For the other 8 flights the emulsions were recovered in good condition after reaching altitudes of 127 to 255 km. (tr-auth)

4717

CONTINUOUS INTEGRALS. I. M. Gel'fand, R. A. Minlos, and A. M. Yaglom. p.521-42 of "Trudy Tret'ego Vsesoyuznogo Matematicheskogo S'ezda, Moscow, June-July, 1956, Vol. III." Moscow, Akademii Nauk SSSR, 1958. 599p. (In Russian)

The method of continuous or functional integrals is applied for describing physical systems with infinite degrees of freedom (quantum fields, statistics of continuous media, etc.). (R.V.J.)

4718

GENERALIZED FUNCTIONS IN FIELD THEORY. O. S. Parasyuk. p.558-66 of "Trudy Tret'ego Vsesoyuznogo Matematicheskogo S'ezda, Moscow, June-July, 1956, Vol. III." Moscow, Akademii Nauk SSSR, 1958, 599p. (In Russian)

Certain aspects of applications of generalized functions in quantum field theory are analyzed. The quantum field theory subtraction formalism is determined by the theory of generalized functions. Purely physical principles, mainly the causality principle, were also used in determining the subtraction operation, and the close bond between the causality and analytical continuance was revealed. (R.V.J.)

Cosmic Radiation

4719 NYO-2131

Massachusetts Inst. of Tech., Cambridge.

FUEL CYCLES IN NUCLEAR REACTORS. [Period covered]: September 1957–August 1959. Raymond T. Shanstrom, Manson Benedict, and Charles T. McDaniel. 396p. Contract AT(30-1)-2073. OTS.

Contents of this report submitted as a thesis by Raymond T. Shanstrom.

A new IBM 704 computer code, FUELCYC, was developed for studying the effect on the fuel cycle of different methods of scheduling replacement of fuel and movement of control poisons. Four alternate fuel scheduling methods were built into the code and provision is made for the addition of other methods. The fueling techniques available in the code are: (1) "Batch," the replacement of the entire fuel charge at one time, with uniform control poisoning during the irradiation; (2) "Inout," the progressive shifting of fuel rods from inner positions to outer positions; (3) "Outin," the progressive shifting of fuel rods from outer positions to inner positions; and (4) "Graded," the periodic replacement of the most irradiated fuel rod among different local groups of rods. FUELCYC is designed for the study of fuel cycles in large power reactors with azimuthal symmetry, which are fueled with U^{235} , U^{238} , and the higher nuclides in their irradiation chains. It is a two-dimensional code in which neutron leakage occurs from two energy groups and neutron absorptions are allowed in the thermal group and also in one of four resonance groups for each fuel nuclide. Local properties are homogenized into cells. FUELCYC calculates the criticality factor, the flux distribution, the power density distribution, the burnup, the fuel cycle cost, and other properties during the life history of the fuel, taking into account the buildup and decay of nuclides in the fuel irradiation chains. An iterative method for solution of the flux distribution was developed which converges even for very coarse mesh spacings, and allows a typical fuel cycle problem to be solved, with good accuracy, in from three to five minutes. (auth)

4720

RELATION BETWEEN SOLAR EMISSIONS OF COSMIC RAYS AND FLARES OF TYPE IV. Yvette Avignon and Monique Pick-Gutmann. *Compt. rend.* **249**, 2276–8 (1959) Nov. 30. (In French)

A close relation is established between type IV flares of an intensity greater than a fixed energy and increases of cosmic radiation observed in the vicinity of the earth. Heliographic coördinates and the importance of the associated optical eruption were taken into account. (tr-auth)

4721

ESTIMATE OF THE SPECIFIC IONIZATION CAUSED BY HEAVY COSMIC RAY PRIMARIES IN TISSUE OR WATER. T. Foelsche (Univ. of Frankfurt am Main). *J. Astro-nautical Sciences* **6**, 57–62(1959).

The specific ionization caused by the primary particles of carbon, neon, iron, and niobium along their paths in water is calculated by use of the formulas of Bohr, Bethe, and Bloch, for the average stopping power. The maximum specific ionization and shape and also half width of the maximum on the end of the path of the particles is estimated according to the considerations about capture and loss of electrons made by Bohr, Brunings, Knipp, Teller, and Bell. (auth)

4722

THE RELATION OF COSMIC RADIO EMISSION TO THE ELECTRONIC COMPONENT OF COSMIC RAYS. Harriet

Tunmer (Mullard Radio Astronomy Observatory, Cambridge, Eng.). *Monthly Notices Roy. Astron. Soc.* **119**, 184–93(1959) June.

The similarity between the spectra of cosmic rays and of the relativistic electrons responsible for cosmic radio waves suggests that the electrons may derive from the collisions of primary cosmic rays with the interstellar gas. The relation to be expected from this process is examined, and it is shown that the form of the electron energy spectrum is determined primarily by the different losses which prevail for different parts of the electron energy spectrum. It is found that the observed spectra of various different types of radio source agree with the theoretical spectra, and that it is possible to obtain information on various physical conditions in the radio sources. (auth)

4723

PRIMARY HEAVY COSMIC RAYS NEAR THE GEOMAGNETIC EQUATOR. O. B. Young and F. W. Zurheide (Southern Illinois Univ., Carbondale). *Nuovo cimento* (10) **14**, 90–8(1959) Oct. 1. (In English)

G-5 emulsions were exposed in February 1957 during Operation EQUEx on two flights of about 100,000 foot altitudes for about 7.5 hr each. Tracks of nuclei of $Z \geq 10$ were studied. The δ -ray method of counting was used. Results are given for the angular distribution, charge spectrum, flux at the top of the atmosphere, and attenuation mean free path. (auth)

4724

MEASUREMENT OF PRIMARY DIRECTIONS IN EXTENSIVE AIR SHOWERS. C. B. A. McCusker (Dublin Inst. for Advanced Studies). *Phys. Rev.* **116**, 177–80(1959) Oct. 1.

The abilities of various extensive shower arrays to detect possible departures from isotropy of the directions of incidence of very high-energy cosmic-ray primaries are analyzed. The effects of angular resolution, selectivity of total energy and sensitivity to the nature of the primary are discussed. A simple method of analyzing variation in intensity with declination is given and applied to some recent experimental results. It is shown that in two well-known cases these are not consistent with the hypothesis of isotropy of incoming directions. (auth)

Criticality Studies

4725 CF-59-12-2

Oak Ridge National Lab., Tenn.

THE ANALYSIS OF FLUX-TRAVERSE MEASUREMENTS IN THE GWIN-MAGNUSON CRITICAL EXPERIMENTS. E. Inonu. Dec. 1, 1959. 6p. OTS.

One set of the experiments consisted of flux traverse measurements taken along the vertical axis of two critical cylinders (of height 19 and 42 in.) with U^{235} , cadmium-covered U^{235} , and U^{238} fission chambers. When the data were fitted with a cosine distribution $y = B_0 \cos B_2(z + B_3)$, the extrapolation lengths for the three distributions did not agree with each other as well as expected. Agreement was improved by refitting the data and leaving out points within 3 and 5 in. of the ends of the 19-in. cylinder and within 7 in. of the ends for the 42-in. cylinder. (W.D.M.)

4726 RFP-169

Dow Chemical Co. Rocky Flats Plant, Denver.

ISOLATION THICKNESSES OF WATER FOR UO_2F_2 SOLUTION SYSTEMS. C. L. Schuske and A. N. Nickel. Dec. 21, 1959. 11p. Contract AT(29-1)-1106. OTS.

Previously published data were used for an empirical study of critical arrays of slab and cylindrically shaped

vessels interacting through water. These vessels contained an aqueous solution of UO_2F_2 and the U^{235} isotopic enrichment was greater than 90%. Approximate isolation thicknesses of water for each of the above two cases are given. (auth)

Elementary Particles

4727 NP-8141

Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics.

MINIMUM ERROR IN THE EXPERIMENTAL DETECTION OF AN ASYMMETRY. N. P. Klepikov. 1959. 6p. (P-364).

Many experiments with elementary particles aiming at the proof of the conservation of spatial parity or at the proof of the existence of spin of a particle reduced finally to the detection of a specific asymmetry in the distribution of particles emerging from some reaction. An estimate is presented of the probability of an error made in the deduction of a conclusion about the presence or absence of an asymmetry from such an experiment. (W.L.H.)

4728 NP-8142

Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics and Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems. SCATTERING OF γ -RAYS BY NUCLEONS NEAR THE PRODUCTION THRESHOLD OF MESONS. L. I. Lapidus and Chou Kuang-chao. 1959. 35p. (P-372).

The elastic scattering of γ -rays by nucleons near the production threshold of a single meson is considered with the help of dispersion relations. It is shown, that the production of mesons in the S-state leads to a cusp dependence of the scattering amplitude, the cross section and other observable quantities near the threshold. For forward γ -N-scattering 6-dispersion relations are obtained which do not contain infrared divergence or arbitrary constants. With some definite assumptions on the analysis of photoproduction data, the scattering amplitude, differential and total scattering cross section with polarized and unpolarized γ -rays, and also the polarization of the recoil nucleon above the threshold are calculated as functions of energy up to 220 Mev. (auth)

4729 NP-8143

Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems.

REACTION $p\pi \rightarrow p\pi^0$ IN THE ENERGY RANGE FROM THE THRESHOLD TO 665 MEV. A. F. Dunaitzev and Yu. D. Prokoshkin. 1959. 19p. (P-405).

By a combined investigation of neutral pion production in p-d and p-p collisions data were obtained on the magnitudes of the total cross sections and angular distributions for the reaction $p\pi \rightarrow p\pi^0$ in the energy range from the threshold to 665 Mev. The comparison of these cross sections with those from other reactions shows that the requirement which the hypothesis of the isotopic invariance imposes on the relation between the total cross sections for various reactions of pion production is fulfilled in the investigated energy region within the experimental error (up to 10%). The pion production in the state with the isotopic spin $T = 1$ is approximately twice as intensive as in the state with $T = 0$. The angular distribution of neutral pions produced in nucleon-nucleon collisions at an energy of about 650 Mev was found to be close to isotropic in contrast to that of the charged pions which is essentially anisotropic by the data of Neganov and Savchenko. This difference contradicts the hypothesis of the isotopic in-

variance. The latter conclusion has, however, some objections and is of a preliminary character. (auth)

4730

MASS REVERSAL AND THE INTERACTIONS OF ELEMENTARY PARTICLES. K. [L.] Nagy (Roland Eötvös Univ., Budapest). *Acta Phys. Acad. Sci. Hung.* 10, 441-8 (1959).

After grouping fermions into isotopic doublets (n,p); (μ, μ^+); (e, ν), it is supposed that the mass reversal transformations should be carried out simultaneously for the two members of each doublet. It is required that all interactions of the elementary particles should be invariant under the mass reversal transformation defined above and also under the γ_5 transformation for massless particles. This invariance principle in the case of weak interactions chooses the $V \pm A$ interaction, leaving the values of the coupling constants arbitrary. The strong nucleon— π and nucleon—K interactions are also invariant. The supposed strong parity-conserving μ —K interaction may be only of four-vector isoscalar type. The possibility of a parity non-conserving μ —K interaction is also mentioned. (auth)

4731

γ_5 INVARIANCE AND THE VANISHING OF THE OBSERVABLE MASSES. K. L. Nagy (Roland Eötvös Univ., Budapest). *Acta Phys. Acad. Sci. Hung.* 10, 449-50 (1959).

In mass origin problems, γ_5 invariance for the observed mass of the elementary particle must be eliminated in order to retain the field theoretical origin of the observed masses. It is shown that $\underline{m} = 0$ ($\underline{m}$ is the real mass of a fermion) follows directly from perturbational calculations of any order by using the technique of the renormalization theory. The problem is confined to treatment of the situation found in quantum electro-dynamics, although problems in other renormalizable theories can be treated in a similar manner. (J.S.R.)

4732

THE WIDTH AND INTENSITY DISTRIBUTION OF THE COMPTON LINE. Zs. Csoma (Universität für Technische Wissenschaften, Budapest). *Acta Phys. Acad. Sci. Hung.* 10, 461-4 (1959). (In German)

The calculations of A. Konya for the electron distribution in the narrow Compton band are applied to the Gombas statistical atomic model expanded by kinetic energy corrections and to the statistical model in which the electrons are grouped according to the principal quantum number. The values obtained for neon agree with the experimental results. (J.S.R.)

4733

IMPLICATIONS OF PARITY NONCONSERVATION AND TIME REVERSAL NONINVARIANCE IN ELECTROMAGNETIC INTERACTIONS. II. ATOMIC ENERGY LEVELS. Mendel Sachs and Solomon L. Schwebel (Lockheed Missiles and Space Div., Palo Alto, Calif.). *Ann. Phys. (N.Y.)* 8, 475-508 (1959) Dec.

The implications of the parity nonconserving and time reversal noninvariant theory of electromagnetic interactions with regard to the properties of atoms and their associated spectra, are investigated. The modified Dirac equation for the hydrogen atom, in which the extra pseudovector part of the four potential (B_μ) is included, is solved exactly. The solutions are found to depend on a new constant of the motion which replaces the conventional angular momentum operator. This new constant is made up in part of the conventional pseudovector angular momentum (particle) variable and in part of a vector function of the particle and field variables. The results are applied to s

determination of new selection rules for magnetic and electric dipole transitions (which are forbidden in the conventional theory) and the calculation of the associated transition probabilities. The contribution of the pseudovector four potential to the measured value of the Lamb shift is calculated. It is found that, analogously to the linear Stark effect in hydrogen, there is a non-Zeeman type linear magnetic field effect in the first excited state of hydrogen. This effect is linear in the mixing parameter ξ . The value of ξ required to account for the present-day discrepancy between the calculated value of the Lamb shift and its measured value, would still insure compatibility with other experimental data. It is also found that the lifetimes of atomic states depend on ξ^2 , thus having much less effect on the metastability of the $2S_{1/2}$ state of hydrogen. The relationship between the crystalline field interactions with the magnetic ions and time reversal invariance is emphasized. A sample perturbation calculation of the pseudoscalar interaction implied by this theory is carried out for the case in which a magnetic ion is subjected to a crystalline field (whose symmetry group lacks an inversion center) and/or an externally applied uniform electric field. (auth)

4734

THE SCATTERING OF FAST NUCLEONS FROM NUCLEI. A. K. Kerman (Massachusetts Inst. of Tech., Cambridge); H. McManus (Chalk River Lab., Ont.) and R. M. Thaler (Los Alamos Scientific Lab., N. Mex.). Ann. Phys. (N. Y.) **8**, 551-635(1959) Dec.

The formal theory of the scattering of high-energy nucleons by nuclei is developed in terms of the nucleon-nucleon scattering amplitude. The most important approximations necessary to make numerical calculation feasible are then examined. The optical model potential is derived on this basis and compared with the optical model parameters found from experiment. The elastic scattering and polarization of nucleons from light nuclei is predicted and compared with experiment. The effect of nuclear correlations is discussed. The polarization of inelastically scattered nucleons is discussed and predictions compared with experiments. To within the validity of the approximations the experimental data on the scattering of nucleons from nuclei at energies above ~ 100 Mev appears to be consistent with the theory. (auth)

4735

CHERENKOV AND TRANSITIONAL RADIATION OF PARTICLE PASSING THROUGH A LAMINA. G. M. Garibyan and G. A. Chalikyan (Inst. of Physics, Academy of Sciences, Armenian SSR). Izvest. Akad. Nauk Armyan. S.S.R., Ser. Fiz.-Mat. Nauk **12**, No. 3, 49-55(1959). (In Russian)

The radiation field produced by a charged particle moving from one semi-infinite medium ($Z < 0$) to another medium ($Z > 0$), differing from each other in dielectric and magnetic properties, was investigated previously. The present investigations are made of the Cherenkov and transition radiations produced by charged particle in motion through a lamina of matter. (R.V.J.)

4736

PHENOMENOLOGICAL EIGENFUNCTIONS AND POTENTIALS FOR THE DEUTERON GROUND STATE. [PART] I. L. Hulthén and L. T. Hedin (Royal Inst. of Tech., Stockholm). Kgl. Norske Videnskab. Selskabs, Forh. **31**, 14-18 (1958). (In English)

Special functions with correct asymptotic behavior and vanishing at $r = 0$ or a cut-off distance r_c are adjusted to the deuteron data on binding energy, effective range, elec-

tric quadrupole moment, and various values of D-state probability p_D . As expected, the main uncertainty in the eigenfunctions comes from inadequate knowledge of r_c and p_D . (auth)

4737

PHENOMENOLOGICAL EIGENFUNCTIONS AND POTENTIALS FOR THE DEUTERON GROUND STATE. [PART] II. L. Hulthén and L. T. Hedin (Royal Inst. of Tech., Stockholm). Kgl. Norske Videnskab. Selskabs, Forh. **31**, 19-25(1958). (In English)

In the second part of the paper, the potentials corresponding to the phenomenological eigenfunctions for the deuteron ground state are derived from the Schroedinger equation and are briefly discussed. (auth)

4738

THE POLARIZATION OF A MUON BEAM IN PION DECAY IN FLIGHT. J. H. D. Jensen (Universität of Heidelberg, Ger.) and H. Øverås (CERN, Geneva). Kgl. Norske Videnskab. Selskabs, Forh. **31**, 34-8(1958). (In German)

The equation describing the polarization of a muon beam as a function of the angle between pion and muon beams was derived directly in the laboratory system. (J.S.R.)

4739

FOLDY-WOUTHUYSEN TRANSFORMATION IN CLOSED FORM FOR SPIN 1/2 PARTICLE IN TIME. INDEPENDENT EXTERNAL FIELDS. Erik Eriksen. Kgl. Norske Videnskab. Selskabs, Forh. **31**, 39-46(1958). (In English)

4740

PHOTOELECTRIC EFFECT FROM POLARIZED PHOTONS. [PART] I. Haakon Olsen. Kgl. Norske Videnskab. Selskabs, Forh. **31**, 61-5(1958). (In English)

The photoelectric cross section and electron polarization from arbitrarily elliptic polarized photons are considered in the same approximation used by Sauter (Ann. phys. **11**, 454(1931)). In the first part of the paper the matrix element and the integrals are derived. (J.S.R.)

4741

PHOTOELECTRIC EFFECT FROM POLARIZED PHOTONS. [PART] II. Haakon Olsen. Kgl. Norske Videnskab. Selskabs, Forh. **31**, 66-70(1958). (In English)

In the second part of the paper, equations are derived for the differential cross section and the electron polarization. (J.S.R.)

4742

A NEW MODEL FOR MULTIPLE MESON PRODUCTION AT HIGH ENERGIES. Wieslaw Czyż, Torleif Ericson, and Sheldon L. Glashow (Inst. for Theoretical Physics, Copenhagen and Nordisk Inst. for Teoretisk Atomfysik, Copenhagen). Nuclear Phys. **13**, 516-24(1959) Nov. (2). (In English)

A new approach to the multiple meson production process is proposed, based upon the peripheral nature and energy-independent behavior of high-energy nucleon-nucleon collisions. A specific model suggested by the analogy with Cherenkov radiation is described. (auth)

4743

THE QUASI-ELASTIC SCATTERING OF FAST PARTICLES BY ATOMIC NUCLEI. T. K. Fowler (Oak Ridge National Lab., Tenn.) and K. M. Watson (Univ. of Calif., Berkeley). Nuclear Phys. **13**, 549-75(1959) Nov. (2). (In English)

The scattering of fast particles by atomic nuclei for large momentum transfers and small energy loss is studied. The cross sections may be expanded in inverse powers of the energy of the incident particle, using methods due to Placzek and Wick. The resulting cross sections, when

applied to analysis of experiments, may be used to study short range order in nuclei. An analysis of electron, pion, and proton experiments shows consistent results and also shows in a striking way the effects of the "repulsive core" in two body forces. (auth)

4744

GAMMA RESONANCE SCATTERING AT THE 17.22 MeV LEVEL IN C^{12} . P. Paul and U. Siederlin (The Universität, Freiburg, I. B.). Nuclear Phys. **13**, 576-82(1959) Nov. (2). (In German)

The absolute total cross section for elastic scattering of 17 Mev-lithium gamma rays on carbon was measured. From this the cross section for resonant scattering on the 17.22 Mev level of C^{12} was calculated for an E_1 and E_2 ground state transition. The result confirms the assignment $1-, T = 1$ for this level. A gamma width $\Gamma_\gamma = (500 \pm 180)$ ev for the ground state transition is obtained, which is consistent with the results obtained from elastic proton scattering on this level. (auth)

4745

AN ITERATION METHOD FOR THE SPECIFICATION OF MULTIGROUP BUCKLINGS. A. Foderaro (General Motors Corp., Warren, Mich.). Nuclear Sci. and Eng. **6**, 514-24(1959) Dec.

A method is described for specifying the transverse leakage (buckling) in each energy group of a multigroup solution of the neutron transport equation. For two dimensional geometry a transverse buckling is associated with one direction and the resulting one-dimensional problem is solved; this gives the first estimate of the energy dependent buckling in the first direction. The next calculation uses this energy dependent buckling as the transverse buckling for a one-dimensional calculation in the other direction. As applied to a completely reflected finite cylindrical core, the method uses the core absorptions and leakages obtained from a one-dimensional multigroup calculation to predict the group bucklings to be used in the next iteration in the other direction. The process is repeated until the buckling in each group in each direction converges. The IBM-704 multigroup diffusion code GNU was used in conjunction with this buckling iteration method to compute the equivalent spherical radii of a number of fully reflected finite cylindrical cores for which experimental data are available. The equivalent sphere diameters as calculated by the buckling iteration method deviate from the experimental diameters by an average of two per cent over the range height to diameter ratios from $1/3$ to 5. The converged value of the multiplication constant was found to be independent of the initial guess made for the axial or radial buckling and insensitive to the transverse bucklings assumed for the regions outside the core for all except very small cores. (auth)

4746

INTERPRETATION OF THERMAL NEUTRON MEAN LIFETIME EXPERIMENTS. Fred Holzer and Marshall F. Crouch (Case Inst. of Tech., Cleveland). Nuclear Sci. and Eng. **6**, 545-53(1959) Dec.

The effects of leakage, detector and source perturbation, and the presence of higher modes in the neutron density distribution on a determination of the mean lifetime of thermal neutrons in water are discussed. The methods used in several recent experiments to minimize these sources of error are analyzed, with particular attention paid to the problem of suppressing the higher modes of the neutron density distribution. The effect of moderator dimensions is presented in terms of mode suppression factors for three characteristic moderator sizes. The

mathematical analysis for a proposed large-geometry, high precision mean lifetime experiment is presented, in which the neutron distribution is calculated as a solution to an eigenvalue problem with variable boundary conditions. Three approximations are presented which allow the counter perturbation to be calculated and the mode content controlled. (auth)

4747

USE OF AN ELECTRONIC COMPUTER FOR THE CONSTRUCTION OF EXACT EIGENFUNCTIONS OF ORBITAL ANGULAR MOMENTUM IN L-S COUPLING. E. Abate and E. Fabri (Università, Pisa, Italy). Nuovo cimento (10) **14**, 29-47(1959) Oct. 1. (In English)

The application of a digital electronic computer to the evaluation of exact eigenfunctions of total orbital angular momentum for many-electrons systems is studied. Some unusual features presented by such a problem, as compared with ordinary applications of electronic computers, are discussed. Computations were carried out following the projection operator technique, and results are given for 3 and 4 electrons in d- and f-states, and for 5 electrons in d-states only. (auth)

4748

ON THE DETERMINATION OF THE MEAN LIFE OF μ^- MESONS IN Ca AND Pb. A. Alberigi Quaranta, U. Dore, and F. Pieraccini (Università, Rome and Istituto Nazionale di Fisica Nucleare, Rome). Nuovo cimento (10) **14**, 48-9 (1959) Oct. 1. (In English)

Measurements for the determination of the apparent mean life of μ^- -mesons in Ca and Pb are reported. The values obtained are $\tau = (35.7 \pm 3) \times 10^{-8}$ sec in Ca and $\tau = (7.3 \pm 0.6) \times 10^{-8}$ sec in Pb. The results are in agreement with those obtained by other investigators and with theoretical estimations. (auth)

4749

MESON PRODUCTION IN THE STATIC CHARGED-SCALAR THEORY. E. Kazes (Univ. of Chicago). Nuovo cimento (10) **14**, 74-80(1959) Oct. 1. (In English)

Meson production amplitudes in the charged-scalar theory are shown to satisfy integral equations which in the one meson approximation reduce to the Riemann-Hilbert boundary problem for which the complete solution is given. (auth)

4750

UNIVERSALITY IN THE NON-LEPTONIC DECAY INTERACTION OF HYPERONS. O. Hara (Nihon Univ., Tokyo). Nuovo cimento (10) **14**, 114-18(1959) Oct. 1. (In English)

If the $\Delta I = 1/2$ rule is assumed and some other plausible assumptions are made, decay interactions for Λ and Σ can be determined except for the coupling constants g_Λ and g_Σ . The coupling constants g_Λ and g_Σ were determined from the life times of Λ and Σ , and it was found that they agree within experimental error. (auth)

4751

ON THE TRANSFORMATION PROPERTIES OF STRONG INTERACTIONS. N. Dallaporta and T. Toyoda (Università, Padua and Istituto Nazionale di Fisica Nucleare, Padua). Nuovo cimento (10) **14**, 142-60(1959) Oct. 1. (In English)

By extending the procedure of grouping several baryon states to form many-component spinors obeying symmetry properties which are not apparent for the separate states, a general Dirac equation satisfied by a 32-component spinor including all the known baryon states is proposed and its properties are discussed. The baryon states, apart from the normal space time co-ordinates, are described by two kinds of independent internal parameters: the iso-

spin variables and the hypercharge variables. The K interactions are expressed by two independent terms with two different interaction constants F and F' , each of which is invariant for rotations in a 4 dimensional hypercharge space. The pion interactions are expressed as invariant for rotations in a 3 dimensional isospin space, quite independent from the hypercharge space. Electromagnetic interactions are formulated by the combination of two terms which conform to the experimentally known charge labelings of the different baryon states when a two step separation process is applied to the equation, which leads, for the K transitions, to selection rules expressing the conservation of hypercharge or strangeness as it is formulated in the doublet approximation. The combination of the two K interaction terms results in two kinds of coupling constants $F + F'$ and $F - F'$ for the different interaction terms, disposed in such a way as to explain the observed different self masses of the baryons. It is shown that the 32-component equation is invariant under boson, spinor, and charge conjugation operations separately, which are rigorously valid even when the different baryon masses are included. Aspects of the γ_5 transformation properties of the equation are discussed. The approach seems adequate to unify, under few common points-of-view, the treatment of the baryon states. (auth)

4752

EXPERIMENTAL RESULTS ON PION PRODUCTION COMPARED WITH PREDICTIONS OF THE ISOBAR MODEL. V. Alles-Borelli, S. Bergia, E. Perez Ferreira, and P. Waloschek (Università, Bologna and Istituto Nazionale di Fisica Nucleare, Bologna). Nuovo cimento (10) **14**, 211-24 (1959) Oct. 1. (In English)

The predictions of the model of Lindenbaum and Sternheimer are compared with results obtained from the analysis of the reactions $\pi^- + p \rightarrow \pi^- + \pi^+ + n$ and $\pi^- + p \rightarrow \pi^- + \pi^0 + p$ as observed in an H_2 bubble chamber. It was not possible to find any contradiction and all results concerning momentum spectra and branching ratios are sufficiently well described by the model. In the favorable case: $\pi^- + p \rightarrow \pi^+ + l^- \rightarrow \pi^+ + (\pi^- + n)$, the correct Q-value distribution for the isobar is obtained and angular correlations in its decay are compatible with a $J = \frac{3}{2}$ for the $(\pi^- + n)$ -pair. (auth)

4753

HYPERCHARGE INDEPENDENCE OF K INTERACTIONS. N. Dallaporta and V. De Santis (Università, Padua and Istituto Nazionale di Fisica Nucleare, Padua). Nuovo cimento (10) **14**, 225-32 (1959) Oct. 1. (In English)

The invariance properties of expressions of K interactions employing an interaction Hamiltonian were studied for rotations in the hypercharge space. It is concluded that all reactions should be ruled by both hypernumber and isospin independence, and interaction probabilities should be obtained by the product of a hypernumber amplitude and an isospin amplitude. (C.J.G.)

4754

THE PAIR DISTRIBUTION FUNCTION OF A SYSTEM OF BOSE HARD SPHERES, CALCULATED UP TO THE FIRST ORDER IN α/λ . L. Colin and J. Peretti (Univ. of Maryland, College Park, Md.). Nuovo cimento (10) **14**, 233-4 (1959) Oct. 1. (In English)

The Binary Collision Expansion method is used to derive, to the first order in α/λ , the pair distribution function of a Bose system of hard spheres. (C.J.G.)

4755

FURTHER STUDY OF PROTON-PROTON INTERACTIONS

AT 970 Mev. J. D. Dowell, E. C. Fowler, J. G. Hill, G. Martelli, B. Musgrave, and L. Riddiford (Univ. of Birmingham, Eng.). Nuovo cimento (10) **14**, 235-9 (1959) Oct. 1. (In English)

The experiment on (p,p) interactions performed by Batson et al. was analyzed. It was found that proton polarization took place and that parity was conserved. The computed right hand asymmetry was ~ 0.11 . The distribution in χ , the angle between the pion direction and the line of flight of the isobar in the center-of-mass frame of the isobar, shows a forward-backward asymmetry of 2.64 standard deviations. (C.J.G.)

4756

460 Mev NEGATIVE PION SCATTERING FROM NEUTRONS IN A PROPANE BUBBLE CHAMBER. J. Ballam and J. Hang (Michigan State Univ., East Lansing) and J. H. Scandrett and W. D. Walker (Univ. of Wisconsin, Madison). Nuovo cimento (10) **14**, 240-4 (1959) Oct. 1. (In English)

π^- scattering at 460 Mev by neutrons bound in a carbon nucleus in a propane bubble chamber was examined. The total and differential cross sections were determined. The angular distribution was determined and compared with the angular distribution obtained from (π^+, p) scattering. (C.J.G.)

4757

A SEARCH FOR $(\Sigma^+ p)$ HYPERNUCLEI. R. C. Kumar and F. R. Stannard (University College, London). Nuovo cimento (10) **14**, 250-2 (1959) Oct. 1. (In English)

In a sample of 1200 K^- stars from which 110 Σ^+ hyperons were emitted, only one event was found which could be interpreted as a $(\Sigma^+ p)$ hypernucleus and the identification of this event was uncertain. (C.J.G.)

4758

ON μ -MESON ELECTRON SCATTERING. B. De Tollis (Università, Rome and Istituto Nazionale di Fisica Nucleare, Rome). Nuovo cimento (10) **14**, 253-6 (1959) Oct. 1. (In English)

Assuming a possible coupling of a μ -meson with a spinless boson neutral field, the form factors in $\mu^+ - e$ scattering are evaluated. Both cases of scalar and pseudoscalar σ with non-derivative couplings are covered. It is concluded that for energies of the incident μ^+ up to ~ 15 Bev, there should be no essential corrections to the usual expression for the cross section. (C.J.G.)

4759

THE INELASTIC SCATTERING OF Σ^+ HYPERONS WITH EMULSION NUCLEI. D. H. Davis (University College, London) and B. D. Jones and J. Zakrzewski (H. H. Wills Physical Lab., Bristol, Eng.). Nuovo cimento (10) **14**, 265-7 (1959) Oct. 1. (In English)

The events were observed in the capture of K^- at rest by emulsion nuclei. It is concluded that two inelastic scatterings of Σ^+ were observed, according to the reactions: $\Sigma^+ + p \rightarrow \Sigma^+ + p$ and $\Sigma^+ + n \rightarrow \Sigma^+ + n$. (C.J.G.)

4760

SEARCH FOR NEW NEUTRAL MESONS (THE ρ^0 -MESONS). C. Bernardini, R. Querzoli, G. Salvini, A. Silverman, and G. Stoppini (Comitato Nazionale per le Ricerche Nucleari, Milan). Nuovo cimento (10) **14**, 268-71 (1959) Oct. 1. (In English)

An excitation curve for the reaction of gamma rays on protons in a hydrogen target was obtained by using a scintillation apparatus. No evidence was found for the photoproduction of a ρ^0 -meson. The differential cross section for ρ^0 photoproduction was estimated to be 2 to 3×10^{-31} cm². (C.J.G.)

4761NEUTRON SPECTRA FROM THE $p + d$ REACTION.

C. Wong, J. D. Anderson, C. C. Gardner, J. W. McClure, and M. P. Nakada (Univ. of California, Livermore). *Phys. Rev.* **116**, 164-6(1959) Oct. 1.

The energy and angular distributions of neutrons from the $p + d \rightarrow n + p + p$ reaction were measured for incident protons of energy 6.06, 7.15, 8.90, and 13.5 Mev. The peak in the neutron spectra near the maximum neutron energy is in qualitative agreement with the calculations of Heckrotte and MacGregor. (auth)

4762DISPERSION ANALYSIS OF POSSIBLE PARITY NON-CONSERVATION IN LOW-ENERGY PION-NUCLEON SCATTERING. S. Fubini and D. Walecka (European Council for Nuclear Research, Geneva). *Phys. Rev.* **116**, 194-202(1959) Oct. 1.

An attempt is made to analyze the possible parity non-conservation in low-energy pion-nucleon scattering. The use of relativistic dispersion relations enables us to relate such effects to the possible parity nonconservation in strange-particle production from pion-nucleon collisions. It was shown that large violations of parity conservation in strange-particle production are indeed compatible with small effects in low-energy pion-nucleon scattering. It is suggested that our result might be useful in order to understand the very good evidence for parity conservation in nuclear physics. (auth)

4763DETERMINATION OF THE PION-NUCLEON COUPLING CONSTANT FROM n - p SCATTERING ANGULAR DISTRIBUTION. Peter Cziffra and Michael J. Moravcsik (Univ. of California, Livermore). *Phys. Rev.* **116**, 226-30(1959) Oct. 1.

By the use of a method recently proposed by Chew, the pion-nucleon coupling constant is determined from differential cross sections for neutron-proton scattering. Data at 90 and 400 Mev were used. Details of the extrapolation procedure are discussed and the statistical methods used in interpreting the results are explained. The resulting value of the coupling constant is between 0.06 and 0.07, depending on the range and energy of the data included in the analysis. The discrepancy between this value and the usually quoted 0.08 should not be taken seriously, however, because several nonstatistical uncertainties could not be taken into account. The origin of these uncertainties is discussed. (auth)

4764DECAY OF THE CHARGED PION. R. F. Sawyer (European Council for Nuclear Research, Geneva). *Phys. Rev.* **116**, 231-5(1959) Oct. 1.

The amplitude for pion decay is related to quantities involved in the meson propagator under strong π coupling alone. For pseudovector π coupling the Goldberger and Treiman result follows under certain assumptions, but without an expansion in intermediate states. For pseudoscalar π coupling, similar, but somewhat inconsistent, results are obtainable by means of an equivalence relation applied to the weak interaction. An expansion in intermediate states of the absorptive part of the decay amplitude is related to a similar expansion for the meson propagator and in an approximation yields the Goldberger and Treiman result when states containing one nucleon pair and some number of pions are included. (auth)

4765

TWO PROPOSED EXPERIMENTS FOR THE DETECTION

OF THE DIRAC MONOPOLE. Robert Katz and Darrell R. Parnell (Kansas State Univ., Manhattan). *Phys. Rev.* **116**, 236-8(1959) Oct. 1.

A magnetic monopole may be detected by its deflection in an electric field or by the character of the ionization it produces. The electric deflection experiment may be performed in a helium bubble chamber where helical (or spiral) tracks whose axes are parallel to the D-lines would be certain evidence for the discovery of the monopole. Previous studies of the ionization have emphasized that the Bragg tail would be missing from a monopole track, as compared to a charged particle. This conclusion must be modified because of the thin-down of tracks of heavy nuclei. The tracks of heavy nuclei thicken and then thin down as they approach the end of their range. The tracks of monopoles are wedge-shaped, thinning down continuously as they approach the end of their range. Since the track width is due to knock-on electrons, or delta rays, any search for the monopole using this criterion must be conducted with electron-sensitive emulsions. (auth)

4766INTERFERENCE EFFECTS IN NEUTRAL K-PARTICLE DECAY. S. B. Treiman (Princeton Univ., N. J.) and S. Weinberg (Columbia Univ., New York). *Phys. Rev.* **116**, 239-40(1959) Oct. 1.

An analysis is made of interference effects between the K_1^0 and K_2^0 components of a neutral K beam for decay in the channel $\pi^+ + \pi^- + \pi^0$. The effects discussed, though expected to be small, may just be detectable. If so, they would serve as a test of the proposed $|\Delta T| = \frac{1}{2}$ rule. (auth)

4767MEASUREMENTS ON THE π^+ - p TOTAL SCATTERING CROSS SECTIONS IN THE ENERGY RANGE OF 0.4 TO 1.5 Bev. J. C. Brisson, J. Detoeuf, P. Falk-Vairant, L. van Rossum, G. Valladas, and Luke C. L. Yuan (Centre d'Etudes Nucléaires, Saclay, France). *Phys. Rev. Letters* **3**, 561-3(1959) Dec. 15.

Total scattering cross sections are given for the (π^+, p) and (π^-, p) reactions at 0.373 to 1.150 Bev in hydrogen. (C.J.G.)

4768NEUTRAL BRANCHING RATIOS OF Λ AND K^0 PARTICLES. J. L. Brown, H. C. Bryant, R. A. Burnstein, D. A. Glaser, R. W. Härtung, J. A. Kadyk, D. Sinclair, G. H. Trilling, J. C. Vander Velde, and J. D. van Putten (Univ. of Michigan, Ann Arbor). *Phys. Rev. Letters* **3**, 563-5(1959) Dec. 15.

The neutral branching ratios of Λ and K^0 particles were determined to be 0.33 ± 0.07 and 0.25 ± 0.05 , respectively. (C.J.G.)

4769SEARCH FOR $\pi_{10}^0 \rightarrow 3\gamma$. R. P. Ely and D. H. Frisch (Massachusetts Inst. of Tech., Cambridge). *Phys. Rev. Letters* **3**, 565-7(1959) Dec. 15.

Using three high-Z energy-sensitive Cherenkov counters and a lithium target subjected to a 160-Mev proton beam, a search was conducted for the 3γ decay of π_{10}^0 . The net rate of 3γ decay after corrections at 160 Mev is $1.2 \pm 0.6\%$ of the $\alpha = 150^\circ$ ordinary π^0 equivalent counting rate and at 133 Mev the net rate is $-0.1 \pm 0.5\%$. This rate would correspond to a differential cross section for production of the π_{10}^0 of $(2 \pm 1) \times 10^{-23}$ cm² sterad⁻¹ nucleon⁻¹. (C.J.G.)

4770

HIGH-ENERGY TOTAL CROSS SECTIONS FOR POSITIVE PIONS AND PROTONS ON HYDROGEN. Michael J. Longo, Jerome A. Helland, Wilnot N. Hess, Burton J. Moyer, and

Victor Perez-Mendez (Univ. of California, Berkeley). *Phys. Rev. Letters* **3**, 568-70(1959) Dec. 15.

Total cross sections for the (π^+, p) and (p, p) reactions in hydrogen were determined at 1.4 to 4.0 Bev/c. Values for (π^+, p) ranged from 39.4 to 29.3 mb and for (p, p) from 46.9 to 42.4 mb. (C.J.G.)

4771

μ -MESON DECAY. C. Fronsda (European Council for Nuclear Research, Geneva) and S. L. Glashow (Inst. for Theoretical Physics, Copenhagen and European Council for Nuclear Research, Geneva). *Phys. Rev. Letters* **3**, 570-1(1959) Dec. 15.

Klein-Gordon formalism was used to give an interaction expression for μ -meson decay ($\mu \rightarrow e + \gamma$). The expression obtained is identical to the expression derived from field equations in Kemmer theory for $g_1^{(e)} = 0$ and in general differs only by a direct self-interaction of $J_\lambda^{(e)}$. (C.J.G.)

4772

PHOTODISINTEGRATION OF THE DEUTERON IN THE MEDIUM ENERGY RANGE. J. J. De Swart and R. E. Marshak (Univ. of Rochester, N. Y.). *Physica* **25**, 1001-15 (1959) Oct. (In English)

The photodisintegration of the deuteron is calculated for γ -ray energies in the laboratory at 9.23 to 152.4 Mev. Special attention is given to the range 9.23 to 77.3 Mev, corresponding to nucleon-nucleon scattering in the laboratory from 14 to 150 Mev. In nucleon-nucleon interaction the SM1 potential was employed and for the deuteron the Gartenhaus deuteron with 6.7% D state was employed. The total cross section, angular distribution for unpolarized as well as polarized γ rays and the polarization of outgoing nucleons for unpolarized γ rays are calculated. Where possible a comparison with the experiments is made. It is shown that the photodisintegration can impose conditions on the phase shift sets that will allow several of the proposed phase shift sets at 150 Mev in nucleon-nucleon scattering to be ruled out. (auth)

4773

ON THE MOTION OF A CHARGED PARTICLE IN AN INHOMOGENEOUS MAGNETIC FIELD. H. C. Brinkman (Centraal Laboratorium T.N.O., Delft, Netherlands). *Physica* **25**, 1016-20(1959) Oct. (In English)

The motion of a charged particle in an inhomogeneous magnetic field was studied employing Hellwig's and Kruskal's expansion of the gyration of the particle in a Fourier series. The relation of various constants of motion, the energy of the particle, Kruskal's action integral, and Hellwig's higher order correction of the magnetic moment of the particle, is discussed. (auth)

4774

PARTICULES ÉLÉMENTAIRES. (FEUILLES D'INFORMATION). (Elementary Particles. (Information Sheets)). Monograph No. 4. J. Geheniau. Brussels, Institut Interuniversitaire des Sciences Nucléaires, 1959. 61p. (In French)

The important data relative to elementary particles with commentary are assembled in loose-leaf form. Some theoretical information is included. Additional chapters are to be added, thus the subject is not completely covered. The first part is devoted to information on mass, charge, spin, moments, and other characteristics. The second part deals with interaction phenomena and has chapters on pion-nucleon scattering, pion photoproduction, disintegration modes, and average life. (T.R.H.)

4775

LES LOIS DE CONSERVATION EN PHYSIQUE DES PAR-

TICULES ÉLÉMENTAIRES. (Conservation Laws in the Physics of Elementary Particles). Monographie No. 3. J. Serpe. Brussels, Institut Interuniversitaire des Sciences Nucléaires, 1959. 99p.

The text of a series of five lectures presented in Brussels is compiled. The conservation laws associated with continuous groups of transformations are briefly reviewed as an introduction. The conservation laws associated with symmetry operations are considered with a discussion of spatial inversion, time reversion, and particle-antiparticle transitions. The two-component neutrino theory is discussed. An introduction to the theoretical problems posed by strange particles (which was not included in the lecture series) is given. In an appendix the Pais-Piccioni experiment and the $\Delta t = \pm \frac{1}{2}$ selection law are described. 70 references. (J.S.R.)

Nuclear Properties and Reactions

4776 AERE-M-494

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

THE DECAY ENERGY OF THE FISSION PRODUCTS OF U^{235} . I. J. MacBean. Sept. 1959. 15p. BIS.

The information on the average power emitted as gamma or beta radiation from the fission products formed in thermal fission of U^{235} , as functions of the time after fission is reviewed. Data and calculations are taken from the sources considered to be best at the present time, and some new calculations were made. The total delayed gamma energy is estimated to be 7.0 ± 1 Mev/fission. Graphs of the functions and their integrals are presented in the report by MacBean. A revised estimate of the average total disintegration energy of all fission products has been based on the recent semi-empirical estimates by Hay and Newton of the fission-fragment masses. The result, which is 21.15 ± 0.35 Mev/fission, is surprisingly close to the much earlier estimate by Way and Wigner. (auth)

4777 AERE-R-3033

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

ENERGY RELEASE FROM FISSION PRODUCT DECAY. I. J. MacBean. Sept. 1959. 16p. BIS.

The average power emitted as gamma or beta radiation from U^{235} thermal fission products is calculated as a function of time after fission. Previous work on the subject is surveyed and compared with the present results. (W.D.M.)

4778 LAMS-2359

Los Alamos Scientific Lab., N. Mex.

AN IBM 704 PROGRAM FOR THE COMPUTATION OF CROSS-SECTION IN GAMMA-RAY ZERO-ZERO TRANSITIONS IN NUCLEI. Roger E. Mills and Robert M. Kloepper. Sept. 1959. 19p. Contract W-7405-eng-36. OTS.

An IBM 704 program for the computation of the transition rates for the internal K-electron conversion and pair production processes in monopole nuclear transitions is described. The computations are based on formulas given by Thomas. Also, for the internal conversion transition rates, additional computations are made which are based on formulas stated by Reiner. A table of values of these transition rates for several isotopes is given. (auth)

4779 NP-8137

Lockheed Nuclear Products, Marietta, Ga.

NUCLEAR REACTIONS FOR NEUTRON DETECTION. H. H. Nichols. Jan. 2, 1958. 39p. (ER-2961).

A compilation is presented of nuclear reactions for isotopes about which sufficient data are known to make them useful for neutron spectrum measurements. A selection and reason for selection of reactions useful in thermal, resonant, and threshold type detection are reported. The nuclear reactions were chosen because of availability of data concerning the reactions, high thermal or fast neutron cross sections, convenience of detection and evaluation of induced beta-gamma activity, and their successful use by other organizations. (W.L.H.)

4780 NP-8144

Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics.

ON THE SUPERFLUIDITY OF LIGHT NUCLEI. V. B. Belyaev, B. N. Zakhar'ev, and V. G. Solov'ev (Soloviev). 1959. 8p. (P-414).

The physical ideas and mathematical methods developed in the theory of superconductivity are used for studying properties of light nuclei. Basing on the shell model of the nucleus it is shown that the taking into account of the residual interactions of protons and neutrons near the Fermi surface energy leads to superfluid states. Data on the binding energy of a last neutron in the region $22 \leq A \leq 32$ exhibit the presence of (p-p), (n-n), and (n-p) pair correlations with identical quantum numbers (s,m) related to the superfluidity of light nuclei. (auth)

4781 NP-8145

Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw.

ISOMERIC TRANSITION IN Hg^{199} . Report No. 89/I-A. R. Sosnowski, S. Sterliński, J. Topa, and J. Zylcz. May 1959. 11p.

The spectrum of internal conversion electrons for the isomeric transition in Hg^{199} from the $i_{1/2}$ to the $f_{7/2}$ level was investigated. The energy of the transition was found to be $E = 371.1 \pm 3.5$ kev and the ratios of the internal conversion coefficients $K: L: /M + N/ = 1: 0.57 \pm 0.09: /0.12 \pm 0.07/$. It was found from the $K: L$ ratio that the percent admixture of type E5 transitions to the basic M4 did not exceed 11%. (auth)

4782 NP-8161

Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw.

THE DECAY AND STRUCTURE OF HYPERFRAGMENTS. II. Report No. 111/VII. J. Szymański. Sept. 1959. 12p.

The decay $\Delta\text{He}^5 \rightarrow \alpha + p + \pi^-$ and its relation to the structure of hyperfragments are considered. The energy distribution of the pions in the CM system of the hyperfragment is calculated and the results are compared with experiment. Approximations which were made are discussed and the results are compared with the work of other authors. (W.D.M.)

4783 UCRL-8926

California, Univ., Berkeley. Lawrence Radiation Lab. CHARGED-PARTICLE-INDUCED FISSION: A MASS SPECTROMETRIC YIELD STUDY (thesis). Yung Yee Chu. Nov. 1959. 76p. Contract W-7405-eng-48. OTS.

The products from the fission of U induced by charged particles were studied in a mass spectrometer. Both U^{238} and U^{235} were bombarded with 45.7- and 24-Mev helium ions, and U^{238} was also bombarded with 730-Mev protons and 100-Mev carbon ions. The total chain-yields in the region of the rare-earth elements (mass 140 to mass 155) for most of the above bombardments and a thermal-neutron bombardment of U^{235} were studied by using the isotopic-dilution technique. Independent yields were measured for

all the above bombardments for several shielded nuclides. (auth)

4784 WASH-1026

Nuclear Cross Sections Advisory Group, AEC.

RÉPORTS TO THE AEC NUCLEAR CROSS SECTIONS ADVISORY GROUP, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, TENNESSEE, OCTOBER 28-29, 1959. John A. Harvey. 72p. OTS.

The cross section measurement programs at ANL, BNL, Columbia Univ., Duke Univ., HAP0, LASL, ORNL, Phillips Petroleum, Rice Institute, and UCLRL are reviewed. An informal statement is given of recent developments, changes of emphasis, and preliminary data which are of importance to the cross section measurement program of the AEC. Persons who might make use of these data for serious computations should contact the experimenter directly to verify the numbers. (For preceding report see WASH-1021.) (W.D.M.)

4785

STRONG INTERACTIONS IN THE FOUR-DIMENSIONAL ISOTOPIC SPACE. F. Károlyházy and G. Marx (Roland Eötvös Univ., Budapest). *Acta Phys. Acad. Sci. Hung.* **10**, 421-8(1959).

A new variant of the mathematical scheme in the four-dimensional isotopic spin space is proposed for the particles involved in strong interactions, which is suited to give a review of the relations found by Gell-Mann and others. Nucleons, hyperons of order one, and hyperons of order two are described by spinor quantities B_α , $B_{\alpha\delta}$ and $B_{\alpha\delta\tau}$ respectively, and τ and K mesons by the spinors π_μ^ν and K_δ . A possible connection with the Goldhaber-Györgyi model of hyperons is discussed. (auth)

4786

THE POLARIZATION OF NEUTRONS FROM THE $\text{C}^{12}(\text{d},\text{n})\text{N}^{13}$ REACTION. A. Budzanowski, K. Grotowski, H. Niedwiczkański, and J. Nurzyński (Inst. of Nuclear Research, Krakow). *Bull. acad. polon. sci., Ser. sci., math., astron. et phys.* **7**, 583-7(1959). (In English)

The polarization of neutrons emitted from the stripping reaction $\text{C}^{12}(\text{d},\text{n})\text{N}^{13}$ was investigated at the reaction angle $\theta_{\text{lab}} = 15^\circ$ and deuteron energy $E_d = 12.9$ Mev. The polarization of neutrons connected with the 3.56 Mev energy level in N^{13} nucleus was found to be $-(0.39 \pm 0.11)$. (auth)

4787

ELASTIC AND INELASTIC SCATTERING OF 44-Mev α PARTICLES ON SEPARATED ZINC ISOTOPES. René Beurtey, Philippe Catillon, Robert Chaminade, Henriette Faraggi, André Papineau, and Jacques Thirion. *Compt. rend.* **249**, 1189-91(1959) Nov. 23. (In French)

The elastic and inelastic scattering of 44-Mev α particles on zinc isotopes was studied. The energy spectra obtained are given and show the preferential excitation of the levels at 1 and 2.8 Mev. The angular distributions obtained for Zn^{64} , Zn^{66} , and Zn^{68} are graphed. They show, both for the α group corresponding to the ground state and for those groups corresponding to the levels studied, accentuated oscillations characteristic of diffraction shapes observed in surface interactions. The results are compared with theoretical values for both elastic and inelastic scattering. (J.S.R.)

4788

AVERAGE LIFE OF THE 187-kev LEVEL OF RADON-222. Roger Foucher. *Compt. rend.* **249**, 2310-12(1959) Nov. 30. (In French)

The average life of the 187-kev level of Rn^{222} is $(5 \pm$

$1.5) \times 10^{-10}$ sec or $B(E_2)/e^2 = 0.43 \times 10^{-48}$ cm⁴. This result is briefly discussed with respect to actual theories of collective levels. (tr-auth)

4799

DETERMINATION OF EXCITED LEVELS OF OXYGEN NUCLEI BY A PHOTONEUTRON REACTION. Dror Sadeh. Compt. rend. **249**, 2313-14(1959) Nov. 30. (In French)

By a new and very much more sensitive process, the breaks in the activation curve for the $O^{16}(\gamma, n)O^{15}$ reaction were studied. These breaks correspond to the excited levels in oxygen-16. Four levels in addition to those previously known were determined. (tr-auth)

4790

ON THE DECAY OF As^{76} . R. K. Girgis, R. A. Ricci, and R. Van Lieshout (Instituut voor Kernfysisch Onderzoek, Amsterdam). Nuclear Phys. **13**, 461-72(1959) Nov. (2). (In English)

The gamma rays emitted in the decay of As^{76} were investigated with the help of scintillation spectrometers. Gamma-gamma coincidences were performed using the summing technique with a cylindrical well-type crystal and also with a fast-slow coincidence set-up. New gamma rays of 760, 860, 1530, 1630, 1860, and 2110 kev were found. The existence of the recently reported gamma rays of 2410 and 2640 kev and that of the disputed 1770 kev gamma ray is confirmed. It is shown that both the 560 and 1210 kev gamma peaks correspond to more than one gamma transition. Results of the detailed analysis of the spectrum are given and a decay scheme is proposed. (auth)

4791

THE DECAY OF Br^{76} . R. K. Girgis, R. A. Ricci, and R. Van Lieshout (Instituut voor Kernfysisch Onderzoek, Amsterdam) and J. Konijn (Technische Hogeschool, Delft, Netherlands). Nuclear Phys. **13**, 473-84(1959) Nov. (2). (In English)

The radiations of 16.1 ± 0.2 hour Br^{76} were studied with single-crystal and coincidence scintillation spectrometers; beta-gamma coincidences were also studied with a proportional counter-scintillation crystal coincidence spectrometer. Three positron groups of maximum energies (and relative intensities) of 3.68 ± 0.10 (45^+), 3.15 ± 0.10 (100^+) and 1.9 ± 0.2 Mev ($< 40^+$) were resolved; the ratio of electron capture to positron emission was determined as 0.6 ± 0.2 . The 3.68 Mev positron group is a ground state transition, since it is not in coincidence with the 0.56 Mev gamma ray. A total number of 15 gamma rays with energies ranging from 0.56 to 4.42 Mev were resolved. For a few selected gamma rays coincidence measurements performed with the proportional counter yielded the relative amount of positons feeding these gamma transitions. In view of the complexity of the gamma ray spectrum no unambiguous decay scheme for Br^{76} can be proposed. Some features of the level scheme of Se^{76} are discussed especially in relation to the results obtained from a separate study of the decay of As^{76} . (auth)

4792

GAMMA RADIATION FROM Br^{77} . R. K. Girgis, R. A. Ricci, and R. Van Lieshout (Instituut voor Kernfysisch Onderzoek, Amsterdam). Nuclear Phys. **13**, 485-92 (1959) Nov. (2). (In English)

The gamma ray spectrum emitted in the decay of Br^{77} was studied with a scintillation spectrometer. Energy values and relative intensities of the various gamma rays were determined. In addition to gamma

transitions known from other studies on the decay of Br^{77} , three new weak gamma rays were found. These have energies of 200 ± 10 , 380 ± 10 and 450 ± 10 kev and involve a level at 455 kev in Se^{77} known from Coulomb excitation experiments. A decay scheme is proposed and log ft-values for the various capture branches are calculated. (auth)

4793

INVESTIGATIONS ON THE DECAY OF Ag^{103} , Ag^{104} , AND Rh^{104} . R. K. Girgis and R. Van Lieshout (Instituut voor Kernfysisch Onderzoek, Amsterdam). Nuclear Phys. **13**, 493-508(1959) Nov. (2). (In English)

The Ag^{103} and Ag^{104} isotopes were produced by irradiating Rh^{103} with alpha particles. Bombarding energies of 50, 40, 30, and 20 Mev were used, whereby these isotopes were produced in different proportions, thus facilitating the assignment of the various radiation characteristics. The 60 minute Ag^{103} was found to decay mainly by an ≈ 1.2 Mev positron transition to the ground state of Pd^{103} ; a weak gamma ray of 120 kev may also be present in the decay of this isotope. Gamma rays of 555, 745, 780, 860, 935, 1260, 1340, 1540, 1640, and 1810 kev were assigned with certainty to the decay of the 70 minute Ag^{104} . Most of these gamma rays also occur in the decay of 4.4 minute Rh^{104} , which was examined under the same experimental conditions. No positons with energy > 1.2 Mev are present in the 70 minute Ag^{104} activity. The decay of the 27 minute Ag^{104} shows gamma rays of 555 and 780 kev and two positron groups of 2.6 and 1.9 Mev. A level scheme is proposed for Pd^{104} . (auth)

4794

THE LEVEL SCHEME OF Pd^{104} (ADDENDUM). R. K. Girgis and R. Van Lieshout (Instituut voor Kernfysisch Onderzoek, Amsterdam). Nuclear Phys. **13**, 509-10(1959) Nov. (2). (In English)

The results obtained in the study of the decay of Rh^{104} and Ag^{104} are reviewed in the light of the new spin value reported for 70 minute Ag^{104} . (auth)

4795

THE TOTAL PROTON REACTION CROSS SECTION OF CARBON FROM 10-68 MeV BY A NEW METHOD. Edward J. Burge (King's College, London). Nuclear Phys. **13**, 511-15(1959) Nov. (2). (In English)

Inelastic interactions in scintillators produce a low energy tail in the pulse height spectrum. The fractions of pulses in the tails for protons of various energies are used directly to determine the total reaction cross-section as a function of energy. The method applies only to nuclei in scintillators. Results for carbon are presented for 10 to 68 Mev. (auth)

4796

GAMMA RAY SPECTRA AND PARAMETERS OF NEUTRON RESONANCES IN MERCURY. J. R. Bird, M. C. Moxon, and F. W. K. Firk (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Phys. **13**, 525-40(1959) Nov. (2). (In English)

The gamma spectra from resonant neutron capture in mercury suggest that resonances in Hg^{199} at 33.5, 175, 263, and 315 ev have $J = 1$, while the 128 ev resonance has $J = 0$. These results are in agreement with the results of transmission measurements. Resonance parameters are determined for seven resonances up to 209 ev. The gamma ray spectra for resonances in other isotopes show end points which are in agreement with binding energies calculated from mass measurements. The shape of the various spectra show the presence of fluc-

tuations of at least 5:1 in the intensity of individual gamma rays, from resonance to resonance. The presence of gamma ray peaks at either 368 or 439 kev assists in the allocation of resonances to either Hg^{199} or Hg^{201} . (auth)

4797

THE ENERGY DEPENDENCE OF THE POLARIZATION OF ELECTRONS AND TIME PARITY. A. I. Alikhanov, G. P. Elisseyev, and V. A. Luibimov (Inst of Theoretical and Experimental Physics, Academy of Sciences, Moscow). *Nuclear Phys.* 13, 541-8(1959) Nov. (2). (In English)

New measurements of the energy dependence of the polarization of the β -electrons from RaE show no significant violation of time parity. (auth)

4798

HIGH ENERGY NUCLEAR DISINTEGRATIONS. E. Tamai (Rikkyo (St. Paul's) Univ., Tokyo). *Nuovo cimento* (10) 14, 1-10(1959) Oct. 1. (In English)

The disintegrations of heavy nuclei (Ag or Br) in a nuclear emulsion by a proton beam of 6.2 Bev were examined. The probabilities of emission of protons, α -particles, Li, Be, B, and C fragments from stars at given excitation energies were investigated, and these experimental results were compared with those calculated by the evaporation theory. (auth)

4799

ON THE BETA DECAY URANIUM X_2 . H. Schneider, P. W. de Lange, and J. W. L. de Villiers (South African Council for Scientific and Industrial Research, National Physical Research Lab., Pretoria). *Nuovo cimento* (10) 14, 11-28(1959) Oct. 1. (In English)

The β - and γ -ray spectra observed in the decay of UX_2 (1.175 min half life in Pa^{234}) are investigated. β - γ -coincidences, obtained in a β -ray spectrometer, as well as γ - γ -coincidence measurements with selected energies are described. In the β -spectrum 11 partial spectra, leading to different states in the daughter nucleus U^{234} , are resolved and their log ft values are given. The high energy part of this spectrum, which was always assumed to go to the ground state, is shown to be highly complex containing 5 partial spectra. The log ft value of the ground state transition is found to be 6.9, indicating the same degree of forbiddenness as observed for the transition Th^{234} to Pa^{234} . Spin assignment is made to UX_2 and some excited states in U^{234} . A decay scheme is presented. (auth)

4800

CHARGED PHOTOPARTICLES FROM ARGON. V. Emma, C. Milone, R. Rinzivillo, and A. Rubbino (Università, Catania, Italy and Centro Siciliano di Fisica Nucleare, Catania, Italy). *Nuovo cimento* (10) 14, 62-73(1959) Oct. 1. (In English)

The (γ, p) and (γ, α) reactions in argon were studied by irradiation of an Ar gas target with the bremsstrahlung beam of 31 Mev. Three different maximum bremsstrahlung energies were used: 23, 26, and 30 Mev. The charged photoparticles emitted at an angle around 90° with the γ -ray beam were recorded by nuclear emulsion. Tracks with a total range $< 75 \mu\text{m}$ of emulsion are attributed mainly to $\text{Ar}(\gamma, \alpha)$ process whose $d\sigma/d\Omega$ is given. Thus the apparent anomaly disappears in the spectrum $\text{Ar}(\gamma, p)$ with a high and narrow peak at energy lower than the Coulomb barrier. The (γ, p) yield appears to be lower than that found by Spicer and McPherson, et al., while seeming to be in agreement with the work of Linderberger on the $\text{Ar}(\gamma, p)$ cross section. (auth)

4801

PHOTONEUTRONS FROM Al. G. Cortini, C. Milone, T. Papa, and R. Rinzivillo (Università, Catania, Italy and Centro Siciliano di Fisica Nucleare, Catania, Italy). *Nuovo cimento* (10) 14, 54-61(1959) Oct. 1. (In English)

The energy spectra of photoneutrons emitted at 90° from Al under bremsstrahlung of 24 and 30 Mev maximum energy were investigated by means of the recoil protons in photoemulsions. The difference between the two spectra shows that above 24 Mev photon energy the neutrons are emitted mainly by a direct process. This process gives a relevant contribution ($> 25\%$) to the photoneutron yield, at 30 Mev. (auth)

4802

STRUCTURES IN THE PROTON SPECTRA FROM n, p, REACTIONS. L. Colli (Università, Milan and Centro Informazione Studi Esperienze, Milan) and F. Cvelbar, S. Micheletti, and M. Pignanelli (Università, Milan and Istituto Nazionale di Fisica Nucleare, Milan). *Nuovo cimento* (10) 14, 81-9(1959) Oct. 1. (In English)

Measurements on proton energy spectra from (n,p) reactions on Mg, Al, Si, and S show the existence of well defined peaks even at excitation energy values where the excitation levels of the residual nucleus are very dense. Comparing the results with some proton spectra from (d,p) reactions, a similarity is found in the position of these peaks on the residual excitation energy scale. By means of this comparison it is possible to establish that the (n,p) reactions go through a mechanism of the type of surface effect, where the residual nucleus is left preferably in some excited states probably corresponding to single particle excitation. (auth)

4803

COINCIDENCE STUDIES OF THE RADIATIONS FROM THE DECAY OF ^{182}Ta . B. P. Singh, H. S. Hans, and P. S. Gill (Muslim Univ., Aligarh, India). *Nuovo cimento* (10) 14, 99-107(1959) Oct. 1. (In English)

γ rays at 68, 100, and 152 kev, and at 1.122, 1.189, and 1.222 Mev were found in the decay of Ta^{182} using a scintillation spectrometer. The 68-kev γ ray was found to be in coincidence with 57 kev, 100 kev, 264 kev, 1.122 Mev, and 1.222 Mev energy γ rays. The 152-kev γ ray was found to be in coincidence with 57 kev, 100 kev, 1.122 Mev, and 1.222 Mev energy γ -rays. The 222-kev γ -ray was found to be in coincidence with 57 kev, 100 kev, and 1.231 Mev energy γ -rays. Two β -ray groups of maximum energy of (560 ± 50) kev and (460 ± 40) kev were found by coincidence studies. These coincidence studies established the levels at 100 kev, 1.222, 1.290, 1.331, 1.374, and 1.554 Mev in W^{182} . (auth)

4804

INVESTIGATIONS OF THE DECAY OF ^{186}W . B. P. Singh and H. S. Hans (Muslim Univ., Aligarh, India). *Nuovo cimento* (10) 14, 108-13(1959) Oct. 1. (In English)

The half life of 57 kev electromagnetic radiation as obtained in the γ -ray spectrum of the decay of W^{186} was measured to be (140 ± 5) days. The 57 kev radiation was assigned to W^{181} . Two more γ rays of low intensity were observed at 136 and 152 kev. By energy and intensity considerations, these γ rays are also considered to be due to W^{181} . The maximum energy of the β -ray group was measured to be (420 ± 20) kev. No genuine coincidences were found between any part of β -ray spectrum and γ -rays and also no γ - γ coincidences were found. Neither the γ ray of 125 kev (0.005%) nor any inner β -ray group can be assigned to the spectrum of W^{185} . (auth)

4805

OBSERVATIONS ON THE PHOTODISINTEGRATION OF ^{16}O THROUGH THE INVERSE PROCESS $^{16}\text{N}(\text{p},\gamma)^{16}\text{O}$. N. W. Tanner and G. C. Thomas (Clarendon Lab., Oxford) and W. E. Meyerhof (Stanford Univ., Calif.). *Nuovo cimento* (10) **14**, 257-9(1959) Oct. 1. (In English)

The high energy γ rays from the $\text{N}^{15}(\text{p},\gamma)\text{O}^{16}$ reaction were analyzed using a NaI crystal scintillation counter. Making allowances for the angular distribution the peak cross section is $110\mu\text{b}$ and assuming $J = 1$, $\Gamma\gamma = 140$ ev. A histogram is presented indicating the position of resonances that might be expected in the $\text{N}^{15}(\text{p},\gamma)\text{O}^{16}$ reaction from the fine structure in the $\text{O}^{16}(\gamma,\text{n})\text{O}^{15}$ reaction. (C.J.G.)

4806

RADIOACTIVE DECAY OF Dy^{160} . B. H. Ketelle and A. R. Brosi (Oak Ridge National Lab., Tenn.). *Phys. Rev.* **116**, 98-101(1959) Oct. 1.

Dy^{160} decay feeds three excited levels in Tb^{160} . Gamma rays with energies of 58, 200, 290, and 350 kev were observed and electron-capture branching ratios were determined. Only L electron capture to the 350-kev level was detected. The half-life of the 58-kev level in Tb^{160} was shown to be less than 1×10^{-9} sec. The K conversion coefficient of the 58-kev gamma ray was measured and found to be 5 ± 1.5 . The disintegration energy of Dy^{160} was shown to lie between 360 and 400 kev; the half-life was remeasured and found to be 144.4 ± 0.2 days. (auth)

4807

ANGULAR DISTRIBUTIONS OF FRAGMENTS FROM NEUTRON-INDUCED FISSION OF U^{235} AND Pu^{239} . L. Blumberg and R. B. Leachman (Los Alamos Scientific Lab., N. Mex.). *Phys. Rev.* **116**, 102-6(1959) Oct. 1.

Angular distributions of fragment activities from neutron-induced fission of U^{235} and Pu^{239} were measured and show in detail the energy dependence of these distributions. The theoretically expected difference in low-energy anisotropy for these nuclides, which have similar fission thresholds but significantly different target spins, was not observed. A statistical model of fission anisotropy is applied to the data from the low-spin target Pu^{239} to determine the energy dependence of K_0 , the standard deviation of the distribution in the angular-momentum projection on the nuclear symmetry axis. The anisotropies indicate an increase of K_0 with energy in excess of the fission barrier, with K_0 values for even-even fissioning nuclei at excitation energies approximately 1 Mev higher than those for odd-A nuclei. The effective moment of inertia about the symmetry axis, similarly obtained from application of a statistical model to the data, is found to be ~ 0.1 that of a rigid spherical nucleus. (auth)

4808

ENERGY DEPENDENCE OF FISSION FRAGMENT ANISOTROPY. James J. Griffin (Los Alamos Scientific Lab., N. Mex.). *Phys. Rev.* **116**, 107-18(1959) Oct. 1.

The dependence on energy of the anisotropy of fission fragment emission is discussed in terms of the Bohr model. It is shown that reasonable assumptions about the spectrum of excited states at the barrier lead to results consistent with the currently available data for energies up to 10 Mev and for a variety of target nuclides, except for the fact that the target spin appears to have a much smaller effect on the anisotropy than was predicted. It is suggested that this anomaly may be understood in terms of the deformation of the target nucleus. (auth)

4809

Tb^{160} : A NEW TERBIUM ISOTOPE. K. S. Toth, S. Bjorn-

holm, M. Jørgensen, O. B. Nielsen, and O. Skilbreid (Univ. of Copenhagen). *Phys. Rev.* **116**, 118-19(1959) Oct. 1.

A new isotope with a 3.1-hr half life was produced in a 60-Mev proton bombardment of natural gadolinium. The isotope was identified to be Tb^{160} by means of a mass separation performed on the chemically purified terbium fraction. Gamma-ray spectra have revealed an intense 640-kev peak belonging to Tb^{160} decay. The γ ray is probably the transition from the first-excited to the ground state in Gd^{160} . (auth)

4810

GAMMA RAYS FROM THE NUCLEAR PHOTOEFFECT IN CARBON, OXYGEN, AND COPPER. A. S. Penfold and E. L. Garwin (Univ. of Chicago). *Phys. Rev.* **116**, 120-30(1959) Oct. 1.

A NaI crystal was used to study the spectra of gamma rays associated with the giant resonance cross section of the nuclear photoeffect in carbon, oxygen, and copper. The x-ray source was a bremsstrahlung beam whose energy was varied from 19 to 61 Mev. Cross sections for elastic, and mixed elastic and inelastic scattering was measured at 135° to the x-ray beam. The copper cross section has a magnitude which is well predicted by particle photoproduction cross sections coupled with a dipole dispersion theory. The elastic scattering cross section for carbon can be predicted in a similar fashion, but the oxygen cross section cannot. For oxygen, the observed cross section is much larger than the predicted one and this result is explained if narrow, isolated resonances are an important part of the oxygen photonuclear cross section. The different behavior of carbon and oxygen which is found is consistent with other experiments. The angular dependence of the oxygen elastic scattering cross section near 22 Mev is predominantly dipole with a possible quadrupole admixture. For oxygen, an inelastic scattering cross section was observed which has a threshold at about 26 Mev, a peak at about 30 Mev, and is due to transitions to a state (or states) near 6 Mev. It is interpreted as the result of an overlap of two giant resonance cross sections—one for the ground state and one for the excited state. The consequences of this interpretation to the theory of the nuclear photoeffect is discussed. The yield of gamma rays from O^{16} and N^{15} which follow neutron or proton emission was also studied and several lines were observed, but none above 6.5 Mev. The photonuclear cross sections associated with these lines are estimated to be 45% of the whole photonuclear cross section at 23 Mev. (auth)

4811

ANGULAR DISTRIBUTIONS OF DEUTERONS FROM $\text{Li}^7(\text{p},\text{d})\text{Li}^6$ REACTIONS. E. F. Bennett and D. R. Maxson (Princeton Univ., N. J.). *Phys. Rev.* **116**, 131-3(1959) Oct. 1.

Angular distributions of deuterons from $\text{Li}^7(\text{p},\text{d})\text{Li}^6$ reactions induced by 17.5-Mev protons on a natural lithium target were observed at angles less than 50 degrees in the laboratory system. Deuteron groups leaving Li^6 in its ground state and in states at 2.19 and 3.57 Mev were studied, and the branching ratios were compared with intermediate coupling shell theory. Pure or nearly pure L-S coupling was found to be adequate to explain the observed ratios. (auth)

4812

DETERMINATION OF THE BETA-DECAY INTERACTION FROM ELECTRON-NEUTRINO ANGULAR CORRELATION MEASUREMENTS. J. S. Allen, R. L. Burman, W. B. Herrmannsfeldt, and P. Stähelin (Univ. of Illinois, Urbana)

and T. H. Braid (Argonne National Lab., Lemont, Ill.). *Phys. Rev.* **116**, 134-43(1959) Oct. 1.

The angular correlation coefficients in the allowed beta decays of He^6 , Ne^{19} , Ne^{23} , and Ar^{36} were experimentally determined from measurements of the energy spectra of the recoil ions. The form of the beta-decay interaction was deduced from these measurements. The experimental results are summarized, giving the beta-decay interaction forms for each measurement. The experimental results are consistent if the dominant beta-decay interaction is the VA combination. (auth)

4813

DECAY OF U^{240} AND 7.3-MIN Np^{240} . M. E. Bunker, B. J. Dropesky, J. D. Knight, J. W. Starnner, and B. Warren (Los Alamos Scientific Lab., N. Mex.). *Phys. Rev.* **116**, 143-53 (1959) Oct. 1.

The radiations of U^{240} and 7.3-min Np^{240} were studied with a solenoidal beta spectrometer, beta- and gamma-scintillation spectrometers, and 180° permanent-magnet spectrographs. The principal decay branch of U^{240} is a 0.36-Mev beta transition to the 7.3-min state of Np^{240} . The only other radiations observed which are attributed to U^{240} are the conversion lines associated with a 0.044-Mev transition. The decay scheme of 7.3-min Np^{240} is considerably more complicated than that indicated by previous investigations. On the basis of coincidence studies, intensity data, internal conversion coefficients, and the measured transition energies, a consistent level scheme for Pu^{240} is proposed which has excited states at 0.043, 0.142, 0.597, 0.858, 0.900, 0.942, 1.42, 1.53, and 1.62 Mev. The ground-state transition from the 0.858-Mev level is of E0 multipolarity, identifying this level as a 0^+ state. There are beta transitions to the ground state of Pu^{240} ($Q_\beta = 2.18$ Mev) and to each of the above excited states except the one at 0.142 Mev. Consideration of the beta-decay information leads to a spin and parity assignment of 1^+ for 7.3-min Np^{240} . Various features of the decay scheme are compared with the predictions of current models of nuclear structure. (auth)

4814

COULOMB EXCITATION OF STATES IN Pt^{195} . F. K. McGowan and P. H. Stelson (Oak Ridge National Lab., Tenn.). *Phys. Rev.* **116**, 154-9(1959) Oct. 1.

Gamma rays of 99, 110, 130, 140, 210, and 240 kev were observed from Coulomb excitation of Pt^{195} (platinum target containing 60.1% Pt^{195}) with 3.0- to 5.5-Mev protons and α particles. The energy dependence of the gamma-ray yields indicates direct excitation of states at 99, 130, 210, and 240 kev. The 140-kev gamma ray is a cascade transition between states at 240 and 99 kev. These results do not agree with the conclusions of Bernstein and Lewis who measured the Coulomb excitation functions of the internal conversion electrons and found evidence for direct excitation of levels at 31 and 130 kev but no evidence for direct excitation of a level at 99 kev. The angular distributions of the 240- and 210-kev gamma rays and the 140-kev gamma ray in coincidence with K x rays from internal conversion of the 99-kev transition were measured with respect to the incident ion beam on a thick target. These measured distributions are consistent with an assignment of $5/2(E2)1/2$, $3/2(E2 + M1)1/2$ with $(E2/M1)^{1/2} = 0.37 \pm 0.02$, and $5/2(E2 + M1)3/2$ with $(E2/M1)^{1/2} = -(0.13 \pm 0.03)$ for the 240-, 210-, and 140-kev transitions, respectively. The B(E2) and B(M1) for decay of these states were determined. (auth)

4815

PRODUCTION OF Be^7 IN 30-42 Mev He-ION BOMBARDMENT OF OXYGEN, ALUMINUM, AND COPPER.

George H. Bouchard, Jr. and A. W. Fairhall (Univ. of Washington, Seattle). *Phys. Rev.* **116**, 160-3(1959) Oct. 1.

The production of Be^7 in targets of oxygen, aluminum and copper bombarded with 30- to 42-Mev He ions was studied using radiochemical techniques. At 40-Mev He-ion bombarding energy the formation cross sections are 2.4 mb, 0.22 mb, and 0.018 mb, respectively. For aluminum and oxygen targets the Be^7 fragments are emitted sharply forward, implying a direct-interaction mechanism. Estimations of the energies of the Be^7 fragments, along with the observation that for Al^{27} target the yield of Na^{24} is equal to the yield of Be^7 , suggests that in this particular case interaction involves the pickup of a He^3 fragment from the nucleus by the impinging He^4 ion with the deposition of less than 7 Mev of excitation energy in the Na^{24} residual nucleus. (auth)

4816

POLARIZATION OF γ RAYS IN Pb^{207} . P. H. Stelson, W. G. Smith, and F. K. McGowan (Oak Ridge National Lab., Tenn.). *Phys. Rev.* **116**, 167-9(1959) Oct. 1.

Polarization-direction measurements were made on the γ -ray transitions in Pb^{207} resulting from the decay of Bi^{207} . These measurements were made to obtain additional information on both the spin of the level at 2.34 Mev and the multipole character of the decay γ ray. The observed polarization eliminates the possible spin assignment $9/2$. It is concluded that the spin assignment is $7/2$ and that the 1.77-Mev γ ray is predominantly M1. (auth)

4817

EVIDENCE FOR THE POLARIZATION OF B^{12} NUCLEI PRODUCED IN A (d,p) REACTION. L. F. Chase, Jr. and G. Igo (Stanford Univ., Calif.). *Phys. Rev.* **116**, 170-2 (1959) Oct. 1.

Evidence is presented that a lower limit for the polarization of B^{12} nuclei produced in the (d,p) reaction at 2.8 Mev is $17 \pm 5\%$. The sign of the polarization P_R is in disagreement with the Newsn model, and it is in agreement with a modified classical model. The sign of the proton polarization determined by Hillman and by Juveland and Jentschke is also in agreement with the modified classical model. (auth)

4818

($\gamma, 2n$) REACTIONS IN LIGHT ELEMENTS. J. O'Connell, P. Dyal, and J. Goldemberg (Univ. of Illinois, Urbana). *Phys. Rev.* **116**, 173-4(1959) Oct. 1.

The yields at several energies for the reactions $\text{C}^{12}(\gamma, 2n)\text{C}^{10}$, $\text{O}^{16}(\gamma, 2n)\text{O}^{14}$, $\text{F}^{19}(\gamma, 2n)\text{F}^{17}$, $\text{Na}^{23}(\gamma, 2n)\text{Na}^{21}$, $\text{P}^{31}(\gamma, 2p)\text{Al}^{29}$, and $\text{P}^{31}(\gamma, 2pn)\text{Al}^{28}$ were measured. It was found that the ratio of integrated cross sections of the ($\gamma, 2n$) to (γ, n) reactions in F^{19} and in Na^{23} is of the order of 0.1 and approximately 1 to 2 orders of magnitude smaller for C^{12} and O^{16} . The small ($\gamma, 2n$) yields for C^{12} and O^{16} are consistent with statistical competition between emitted particles if the gamma-ray absorption decreases rapidly with energy above the giant resonance. (auth)

4819

DIRECT-INTERACTION EFFECTS IN MEDIUM-ENERGY FISSION OF URANIUM. W. J. Nicholson and I. Halpern (Univ. of Washington, Seattle). *Phys. Rev.* **116**, 175-7 (1959) Oct. 1.

The fraction of the fission events which occur after direct interactions rather than after compound nucleus formation was determined in a number of bombardments of uranium. The projectiles used were 10.5-Mev protons, 21-Mev deuterons, and 42-Mev alpha particles. The fraction of post-direct-interaction fissions was obtained from measurements of the angular correlation of coincident

pairs of fission fragments which emerged at approximately 90° to the incident particle beam. The results indicate that $(2 \pm 3)\%$ of fission events in 42-Mev alpha particle bombardments and $(5 \pm 5)\%$ in 21-Mev deuteron bombardments follow some type of direct interaction. (auth)

4820

μ -MESON CAPTURE IN Li^6 LEADING TO THE GROUND STATE OF He^6 . H. Überall (Carnegie Inst. of Tech., Pittsburgh). *Phys. Rev.* **116**, 218-26(1959) Oct. 1.

The rate of the capture reaction of μ^- mesons was calculated in Li^6 leading to the He^6 ground state (Godfrey-type reaction), a process which is expected to give more accurate information on the μ -capture coupling constants than the capture in nuclei leading to all possible final states. Induced pseudoscalar coupling and Gell-Mann's conserved vector current are taken into account, and numerical results are given assuming a universal weak interaction. The Li^6 and He^6 wave functions are taken as shell model states with LS coupling and configuration mixing. It is found that the capture rate is sensitive to the p-shell radius, and for a determination of the latter, the Stanford electron scattering results for Li^6 were analyzed taking into account the recoil motion of the α -particle core; however, the main portion of the radial integral in the theoretical capture rate may be read from the scattering data directly. The capture rate is found to be of the order of $0.4 \times 10^3 \text{ sec}^{-1}$, its exact value still depending on some assumptions about the coupling. (auth)

4821

RECOILLESS RESONANCE ABSORPTION OF GAMMA RAYS IN Fe^{57} . J. P. Schiffer and W. Marshall (Atomic Energy Research Establishment, Harwell, Eng.). *Phys. Rev. Letters* **3**, 556-7(1959) Dec. 15.

An absorber of thin Fe foil (containing 2.2% Fe^{57}) was used with a xenon-filled proportional counter to detect the 14-keV radiation. The number of α rays emerging from the absorber with the source moving with a velocity large compared to the width of the line was $\sim 20\%$ larger than with the source stationary, in good agreement with predictions from the Debye-Waller factor. (C.J.G.)

4822

NUCLEAR FRAGMENTS PRODUCED IN THE HEAVY ION BOMBARDMENT OF ALUMINUM. C. E. Anderson, W. J. Knox, A. R. Quinton, and G. R. Bach (Yale Univ., New Haven). *Phys. Rev. Letters* **3**, 557-9(1959) Dec. 15.

The reaction products lithium, beryllium, boron, carbon, nitrogen, oxygen, and fluorine were produced by bombarding aluminum with 160-Mev oxygen ions. The total cross section for the production of each element was determined. Graphs are given showing the total number of emitted particles of each element (independent of energy) as a function of laboratory angle and showing the energy spectra of emitted carbon fragments in the center-of-mass system at various center-of-mass angles. (C.J.G.)

4823

DISTRIBUTION OF PARTIAL RADIATIVE WIDTHS IN Cu^{59} FOLLOWING PROTON CAPTURE IN Ni^{58} . J. H. Carver and G. A. Jones (Atomic Energy Research Establishment, Harwell, Eng.). *Phys. Rev. Letters* **3**, 559-61(1959) Dec. 15.

Partial radiative widths in Cu^{59} following proton capture in Ni^{58} are reported from the gamma radiation spectra at 0 and 90° to the proton beam. Measurements were made on 48 of the larger resonances. The combined distribution of partial widths of transitions to the ground

state or the first or second excited states (at 0.492 and 0.908 Mev) is presented. (C.J.G.)

4824

RESONANCE REACTIONS, THEORETICAL. Erich Vogt (Atomic Energy of Canada Ltd., Chalk River, Ont.). p.215-58 of "Nuclear Reactions." Volume I. Amsterdam, North-Holland Publishing Co.

To state the formal theory of resonances in its simplest possible terms the problem of the s-wave scattering of a particle by a simple potential well is considered. The various complications which are needed to make the theory hold for nuclear resonances are added to the simple resonance theory. It is aimed to show, at least partially, the range of nuclear cross sections that may be usefully described by the R-matrix theory of Wigner and Eisenbud. The general expression for a differential cross section is derived and special results which apply to the resonance cross sections of one or two levels are given and discussed. A brief description is given of the relation of resonance parameters to the behavior of the nucleus. (W.D.M.)

4825

RESONANCE REACTIONS, EXPERIMENTAL. H. E. Gove (Atomic Energy of Canada Ltd., Chalk River, Ont.). p.259-317 of "Nuclear Reactions." Volume I. Amsterdam, North-Holland Publishing Co.

The experimental aspects of resonant nuclear reactions produced both by charged particles and neutrons for target elements up to about $A = 50$ are considered. Some of the reasons for making experimental investigations in the region of nuclear resonances are discussed and the information which can be obtained is outlined. Reaction and scattering cross sections, both differential and total, are considered. Detailed expressions for these are presented for reactions at a single isolated resonance for the cases in which the reaction products are either two particles or one particle and a gamma ray. Graphs for obtaining reduced widths from observed level widths for protons and neutrons are given. The case of interference between resonances for reaction cross sections is considered. The shape of the yield curves from resonance reactions as they are modified by finite experimental resolution and measurements of total width and resonance energy are dealt with. Measurement of absolute yields is treated and angular correlation measurements are discussed. (W.D.M.)

Particle Accelerators

4826 AECU-4509

Cambridge Electron Accelerator, Mass. PARTICLE EXTRACTION III. Kenneth W. Robinson. Feb. 16, 1959. 13p. (CEA-72). OTS.

A device to extend the operation of a beam extraction system is described for low energies where the radiation loss per turn is ineffective. The device consists of a noisy radiofrequency field which excites the radial betatron oscillations. (auth)

4827 MURA-513

Midwestern Universities Research Assn., Madison, Wis. BEAT FACTORS FOR AN ACCELERATOR WITH A GENERAL MAGNETIC FIELD. G. Parzen. Sept. 21, 1959. 6p. Contract AT(11-1)-384. OTS.

Expressions are obtained for the beat factors of an accelerator with a general magnetic field. Results are also given for the particular case of the scaling FFAG accelerator. (auth)

4828 MURA-515

Midwestern Universities Research Assn., Madison, Wis.
THE $\nu/N \rightarrow 1/3$ RESONANCE. VI. PHASE PLOTS AND
FIXED POINTS OBTAINED COMPUTATIONALLY FOR
SEVERAL EQUATIONS AFFECTED BY THE $\nu/N \rightarrow 1/3$
RESONANCE. L. Jackson Laslett. Oct. 13, 1959. 14p.
Contract AT(11-1)-384. OTS.

Computational solutions were obtained for various non-linear differential equations in which the stability limits are determined by the $\nu/N \rightarrow 1/3$ resonance. The results of this work are presented in the form of phase plots, and a table of fixed-point coordinates is given. (auth)

4829 MURA-535

Midwestern Universities Research Assn., Madison, Wis.
CURRENT SOURCES FOR SCALING MAGNETIC FIELDS.
S. C. Snowdon. Dec. 2, 1959. 22p. Contract AT(11-1)-384. OTS.

It is shown that the solution of magnetostatic problems in the presence of distributed current sources may be expressed in terms of a scalar-type potential and scalar-type quantities representing the current density. Application is made to the solution of magnetostatic problems connected with scaling-type magnetic fields employed in FFAG guide fields. (auth)

4830 NP-8151

Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw.

ALTERNATING GRADIENT FOCUSING IN PROTON
LINEAR ACCELERATOR. II. Report No. 100/VII.
S. Kuliński. Aug. 1959. 15p.

The changes of the orbits for the synchronous particles along the linear accelerator were determined. (W.L.H.)

4831 UCRL-8927

California. Univ., Berkeley. Lawrence Radiation Lab.
BEVATRON OPERATION AND DEVELOPMENT. XXI.
FEBRUARY, MARCH, APRIL 1959. Walter D. Hartsough.
Oct. 26, 1959. 23p. Contract W-7405-eng-48. OTS.

The principal research effort during the quarter was the investigation of K-meson, antiproton, and θ_2^0 -particle decay and interactions. Nuclear emulsions were exposed for external groups to neutral particles, to antiproton and K^- -meson beams, and to the primary proton beam. Deflected-beam studies were continued. The generator shafts were comprehensively surveyed; ultrasonic techniques were used to detect and record shaft discontinuities. (For preceding period see UCRL-8564.) (auth)

4832

10 MEV PARTICLE ACCELERATOR WILL AID NUCLEAR
RESEARCH AT CHALK RIVER. H. E. Gove (Atomic En-
ergy of Canada Ltd., Chalk River, Ont.). Can. Electronics
Eng. 4p.(1958) July.

A brief discussion of the operating principles of the 10-Mev tandem Van de Graaff and its advantages as a research instrument is given. The building which will house the machine and the experimental equipment at Chalk River are described. An example of a typical experimental arrangement is given, including information on the automatic data collecting and recording techniques which will be used. (W.D.M.)

4833

ION PHASE MEASUREMENT TECHNIQUES OF THE
BIRMINGHAM CYCLOTRON. M. Konrad (Inst. Rugjer
Bošković, Zagreb). IRE Trans. on Nuclear Sci. NS-6,
35-40(1959) Mar.

The experimental technique used for internal beam ion phase measurements on a cyclotron is described. Ion

phase measurements were carried out by measuring the target current waveform of a screened two-electrode target with equipment based on a sampling technique, having a resolution of 1.5 μ sec and a sensitivity of 5 μ a/cm deflection. The target current waveform was displayed on a cathode-ray-tube screen against the sine of the cyclotron RF phase or in polar coordinates. (auth)

4834

SOME PROBLEMS IN THE CONSTRUCTION OF AN
ELECTRON LINEAR ACCELERATOR. J. Verhaeghe,
V. Vanhuyse, P. Van Leuven, and J. Turf. Mededel.
Koninkl. Vlaam. Acad. Wetenschap. Belg. 21, No. 8, 3-34(1959). (In Dutch)

Special problems encountered in the construction of the electron linear accelerator of the Natuurkundig Laboratorium der Rijksuniversiteit of Ghent are discussed. The subjects considered are magnetic focusing, magnetic screening of the electron gun cathode, abnormal attenuation-multipactor effects, and electron energy control. (J.S.R.)

Plasma Physics and Thermonuclear Processes

4835 AERE-R-3088

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

STABILIZED PINCH CONFIGURATIONS. J. D. Jukes. Sept. 1959. 15p. BIS.

The theory of Suydam was applied to determine the magnetic field configurations necessary to stabilize certain radial pressure distributions in a linear pinched plasma against helical perturbations. The results confirm the stability of a pinch in which the axial component, B_z , of the field tends to reverse with increasing radius, and also the so-called "unpinch" in which B_z initially increases outwards. (auth)

4836 AFOSR-TN-59-1151

Plasmadyne Corp., Santa Ana, Calif.

RELAXATION HEATING OF A PLASMA BY SURFACE INTERACTION WITH A MAGNETIC FIELD. Technical Note No. 3. R. P. Treat. Oct. 15, 1959. 47p. Project No. 3750. Contract AF49(638)-335. (T-3TN109-335).

The heating of a fully ionized deuterium plasma by collisional relaxation for temperatures of the order of one kev is explored. The model used for the study consists of a long cylindrical plasma column confined and manipulated by an axial magnetic field that is induced by currents flowing in a one-turn coil surrounding the plasma. Conditions are such that the field is excluded from the interior of the plasma. The interaction between plasma and field is essentially a surface phenomenon. The heating due to collisional relaxation is investigated for an idealized cycle. For given ion density and circuit parameters, i.e., the capacitance, inductance, and voltage of the capacitor bank connected to the coil, initial plasma temperatures and initial radii are specified for which there is appreciable collisional relaxation while the plasma remains relatively homogeneous. Since initial temperatures are of the order of 10^{-1} kev and the initial radii, ion densities, and circuit parameters are realizable, the results are encouraging. (auth)

4837 AFOSR-TN-59-1271

Maryland. Univ., College Park.

THE WAVE MOTIONS OF SMALL AMPLITUDE IN A

FULLY IONIZED PLASMA. PART I. WITHOUT EXTERNAL MAGNETIC FIELD. S. I. Pal. Nov. 1959. 25p. Project No. 9781. Contract AF49(638)401. (BN-191).

Wave motions of infinitesimal amplitude in a fully ionized plasma, consisting of singly charged ions and electrons, were investigated. A two-fluid theory was used. There are no externally applied electromagnetic fields. The linearized fundamental equations for both the ions and electrons in the plasma as well as those for the electromagnetic field were constructed and applied to the case of a plane harmonic wave. It was found that the wave motion can be separated into three groups characterizing two transverse waves (which are not distinguishable among themselves) and one longitudinal wave. For a plasma with infinite electrical conductivity, undamped waves may exist. Undamped transverse waves occur only when the frequency ω of the wave is higher than the plasma frequency of the electrons ω_e , and there are no such waves if $\omega < \omega_e$. For longitudinal waves, there is one undamped mode when (ω/ω_e) is smaller than unity. At low frequencies the speed of propagation of this mode is the sound speed of the plasma as a whole. The speed of propagation decreases as the frequency ω of the wave increases and tends to a limiting value equal to the sound speed of the ions of the plasma as if there were no electrons in the plasma. The latter speed is $1/\sqrt{2}$ times the sound speed for the plasma as a whole. When (ω/ω_e) is greater than unity, a second undamped wave can occur. The speed of propagation of this wave is infinite when $\omega/\omega_e = 1$ and decreases toward the limiting value of the sound speed of the electrons as the frequency of the wave increases toward infinity. Various damped waves for finite electrical conductivity were also discussed. (auth)

4838 NASA-TN-D-46

National Aeronautics and Space Administration. Langley Research Center, Langley Field, Va.
PLASMA ACCELERATION BY USE OF GUIDED MICROWAVES. Robert V. Hess and Karlheinz Thom. Dec. 1959. 47p. OTS.

A method is explored which makes use of the radiation pressure of microwaves intensified in a resonant cavity as driving pressure. The success of the method depends on the recent development of microwave generators of extreme power outputs which in the near future should reach 100 megawatts. When used to accelerate the plasma, the radiation can be compared to a gas which, however, is almost free of inertia and can expand with a velocity approaching the velocity of light. (auth)

4839 CEA-tr-R-363

MESURES PAR SONDES DANS LE PLASMA SOUS BASSE PRESSION. (Probe Measurement in Low-Pressure Plasma). Yu. (U.) M. Kagan. Translated into French by B. de Trezvisky from *Vestnik Leningrad. Univ., Ser. Fiz. i Khim.*, No. 4, 63-78(1957). 32p.

A systematic exposition is presented of the results obtained in the last few years by the author in the study of probe measurements in low-pressure plasma. The topics considered include particle motion in the probe field, a precise theory of probe measurements for both spherical and cylindrical probes, a critique of the Langmuir and Mott-Smith theory, an approximation theory for the ionized part of the probe, determination of the plasma characteristics, the two-probe method, and experimental application of the method. (J.S.R.)

4840

FACTORS AFFECTING THE SELF-EXCITATION OF LOW-FREQUENCY OSCILLATIONS IN AN ELECTRIC

DISCHARGE. Luděk Pekárek (Inst. of Physics, Czechoslovak Academy of Sciences, Prague). *Czechoslov. J. Phys.* 8, No. 1, 32-45(1958). (In English)

The influences of the individual factors affecting the production of low-frequency oscillations connected with moving striations in a discharge are analyzed and experimentally verified. From the conception of two mechanisms of feedback, which leads to self-excitation of these oscillations, it follows that the following influence the production of oscillations: 1) the tendency of the plasma to stratification, 2) the length of the positive column, 3) processes in regions at the electrodes, and 4) the external electric circuit. The measurements confirm the influence of all these factors. It is shown that the main factor conditioning the production of oscillations is the property of the plasma of the positive column—its tendency to stratification. The plasma of a glow discharge in neon, in the region of low pressures and currents investigated, has a very strong tendency to stratification with the exception of a small interval in the neighborhood of the pressure of 4 mm Hg and 3 ma current. Low-frequency oscillations and moving striations are therefore very often present in a discharge in neon. The influence of the external circuit on the oscillations investigated was also experimentally proved, but it is very weak. (auth)

4641

LOW-FREQUENCY POSITIVE COLUMN OSCILLATIONS IN A GLOW DISCHARGE IN GASES. Václav Krejčí (Inst. of Physics, Czechoslovak Academy of Sciences, Prague). *Czechoslov J. Phys.* 8, No. 1, 46-56(1958). (In Russian)

An attempt was made to verify experimentally the Granovski theory on the rise of oscillations for which the discharge behaves as a circuit with lumped parameters. The linearized dynamic characteristic of the discharge is obtained, and expressions for the attenuation and frequency of the oscillations are derived. The oscillation frequency was measured as a function of the capacity, the length of the discharge path, and the discharge current in a mixture of 90% Kr and 10% H. Measurements were made of the oscillation frequency as a function of the gas pressure in hydrogen. The static characteristics of the discharge and the magnitude of the parasitic capacity, parallel to the discharge tube, were also measured. A qualitative study was made of the changes in the attenuation of the oscillations. The results obtained are in good agreement with theory. (J.S.R.)

4042

EMISSION OF RELATIVISTIC ELECTRON MOVING ALONG THE PLASMA CIRCUMFERENCE. M. L. Ter-Mikaelyan (Inst. of Physics, Academy of Sciences, Armenian SSR). *Izvest. Akad. Nauk Armyan. S.S.R., Ser. Fiz.-Mat. Nauk* 12, No. 3, 96-9(1959). (In Russian)

Studies were made of the radiation emission by relativistic electrons moving in plasma in a magnetic field. The effect of the magnetic field on the dielectric constant is neglected, the radiation frequency being considered to exceed the Larmor purity of electron precession. An analysis is made of the case where $\Sigma > 0$ and the plasma is transparent. (R.V.J.)

4843

NONLINEAR ALFVÉN WAVES IN A COLD IONIZED GAS. David Montgomery (Princeton Univ., N. J.). *Phys. Fluids* 2, 585-8(1959) Nov.-Dec.

Nonlinear constant-profile Alfvén waves were studied in an ionized gas in which thermal motions are negligible. The system of differential equations possesses numerous

integrals, and can be solved up to a single quadrature. Many properties of the waves can be inferred without performing any numerical integrations. The waves necessarily involve nonzero magnetic field components in both directions perpendicular to the direction of propagation, and plane polarized waves are impossible except in the special case of equal mass particles. Circularly polarized modes are also a special case, and, unlike the more general solutions, involve neither longitudinal electric fields nor compression of the gas, (auth)

4844

HIGH-SPEED SHOCK WAVES IN A MAGNETIC ANNULAR SHOCK TUBE. Richard M. Patrick (Avco-Everett Research Lab., Everett, Mass.). *Phys. Fluids* 2, 589-98 (1959) Nov.-Dec.

Experiments were carried out with two magnetic field configurations ahead of the shock front, the first with a magnetic field ahead of the shock front in the direction of motion of the shock. In the second configuration the magnetic field ahead of the shock had its principal component in the plane of the shock front and a small component in the direction of the shock motion. The continuum radiation emitted by the shock-heated plasma was measured with photomultipliers. Use of probes to measure the change in the local magnetic field in the shock front was investigated. With the second configuration, shock velocities in excess of 4×10^7 cm/sec were measured in hydrogen. For these high-speed shock waves, shock thicknesses, obtained from measured rise times of the emitted visible radiation, are thinner than the mean free path in the shock-heated plasma, an observation which agrees with a theoretical prediction. (auth)

4845

THEORY OF THE FLOW IN THE MAGNETIC ANNULAR SHOCK TUBE. Nelson H. Kemp and Harry E. Petschek (Avco-Everett Research Lab., Everett, Mass.). *Phys. Fluids* 2, 599-608(1959) Nov.-Dec.

The magnetic annular shock tube uses a magnetic field to drive a shock wave through an annular region, producing a very high-temperature plasma. It is shown that this particular configuration allows a fairly precise calculation of the flow parameters. Numerical calculations of the significant flow properties for a complete range of the initial field strength and orientation were made and are presented graphically. (auth)

4846

MOVING MAGNETIC FIELD BEHIND A STRONG DEUTERIUM SHOCK. F. R. Scott and R. F. Wenzel (General Atomic Div., General Dynamics Corp., San Diego, Calif.). *Phys. Fluids* 2, 609-13(1959) Nov.-Dec.

By introducing a spiral in the return conductor of a conical discharge tube with a hollow electrode, a magnetic multipole was observed propagating down a cylinder extending out from the hollow electrode. This magnetic field appears to have an extremely complicated internal structure when observed with small magnetic probes; when observed by an external loop, the net axial leakage flux shows a structure consistent with the characteristics of a shock produced deuterium plasma. (auth)

4847

FLOW OF AN INCOMPRESSIBLE FLUID IN A HYDRO-MAGNETIC CAPACITOR. C. C. Chang and T. S. Lundgren (Univ. of Minnesota, Minneapolis). *Phys. Fluids* 2, 627-32(1959) Nov.-Dec.

An incompressible electrically conducting fluid is contained in a torus of rectangular cross section. A uniform

magnetic field is maintained along the polar axis of the tube. A radial electric field is suddenly applied, causing the fluid to flow through the tube. Over-all properties such as the time required to reach steady state, resistance, and capacitance are calculated, and an equivalent electrical circuit is given. (auth)

4848

MAGNETOHYDRODYNAMIC WAVES IN WAVE GUIDES. Ryszard Gajewski (Inst. for Nuclear Research, Warsaw, Poland). *Phys. Fluids* 2, 633-41(1959) Nov.-Dec.

Propagation of magnetohydrodynamic waves is investigated in a fluid bounded by a cylindrical surface of constant, but not necessarily circular, cross section. The fluid is assumed to be nonviscous and perfectly conducting with a constant magnetic field applied parallel to the walls of the cylinder. It is shown that the following types of waves can propagate in such a wave guide: (1) transverse waves propagating without dispersion with the velocity of Alfvén waves; (2) a longitudinal wave, identical with the wave of the principal mode for an acoustic wave guide; (3) waves having both longitudinal and transverse components propagating with a dispersion, their group and phase velocity being close to the respective velocities for an acoustic wave guide; (4) waves having both longitudinal and transverse components propagating with a small dispersion, their group and phase velocity being close to the velocity of Alfvén waves. When the applied frequency is too low, damping of certain modes appears, for waves of type (3), only; the cut-off frequencies turn out to be slightly higher than the corresponding cut-off frequencies for an acoustic wave guide. (auth)

4849

INSTABILITY OF CERTAIN ELECTROHYDRODYNAMIC SYSTEMS. Otmar M. Stuetzer (General Mills Inc., Minneapolis). *Phys. Fluids* 2, 642-8(1959) Nov.-Dec.

The production of ion drag pressure under dynamic conditions, i.e., with the carrier medium in motion, is theoretically investigated. It is shown that for constant applied voltage the pressure increases with increasing velocity of the carrier fluid. This can lead to instability of the system which is theoretically discussed and experimentally demonstrated. (auth)

4850

ELECTROSTATIC FIELD ABOUT AN ION MOVING SLOWLY IN A PLASMA. S. Rand (Convair, San Diego, Calif.). *Phys. Fluids* 2, 649-55(1959) Nov.-Dec.

A particle treatment is used to determine the potential distribution about an ion moving subsonically through a plasma. A fore-aft asymmetry is obtained which has the effect of producing a drag on the ion. This asymmetry is the most important difference between the results of this treatment and those obtained for the subsonic case by the linearized treatment of the electrohydrodynamic equations. (auth)

4851

OSCILLATIONS IN THE B-1 STELLARATOR. W. Bernstein, A. Z. Kranz, and F. Tenney (Princeton Univ., N. J.). *Phys. Fluids* 2, 713-14(1959) Nov.-Dec.

Regular oscillations in the range 30 to 200 kc were observed in the B-1 stellarator during ohmic heating discharges in helium. The rise time of the ohmic heating accelerating voltage was slowed to about 600 μ sec enabling almost linear production of a current to the Kruskal limit in about 1 m sec. Above the Kruskal limit for the $m = 1$ mode the optical scans show that the discharge column moves laterally as a whole. The currents evaluated at

the limits for the $m = 1, 3, 4$ "modes" of oscillation are proportional to the magnitude of the confining field from 27,000 to 14,000 gauss. At the lower limit of axial current for which the m^{th} mode instability occurs, the effective rotational transform of the axial magnetic field is $2\pi/m$. (C.J.G.)

4852

OCCURRENCE OF VAVILOV-ČERENKOV RADIATION IN A HIGH-TEMPERATURE PLASMA. Jacob Neufeld (Oak Ridge National Lab., Tenn.). *Phys. Rev.* **116**, 1-3(1959) Oct. 1.

Akhiezer and Sitenko investigated the energy loss of a charged particle moving through a plasma at a velocity considerably lower than the mean thermal velocity of the electrons in the plasma and determined the component of the stopping power due to the transverse electric field produced by the plasma and acting upon the particle. The presence of such a component may in some instances be associated with the occurrence of the Vavilov-Cherenkov radiation. It is shown, however, that in this particular case the field surrounding the particle decreases very rapidly with the distance from the particle and no radiation takes place. (auth)

4853

STARK BROADENING OF HYDROGEN LINES IN A PLASMA. Hans R. Griem (Univ. of Maryland, College Park and Naval Research Lab., Washington, D. C.); Alan C. Kolb (Naval Research Lab., Washington, D. C.), and K. Y. Shen (Univ. of Maryland, College Park). *Phys. Rev.* **116**, 4-16(1959) Oct. 1.

The frequency distributions of hydrogen lines broadened by the local fields of both ions and electrons in a plasma are calculated in the classical path approximation. The electron collisions are treated by an impact theory which takes into account the Stark splitting caused by the quasi-static ion fields. The ion field-strength distribution function used includes the effect of electron shielding and ion-ion correlations. The various approximations that were employed are examined for self-consistency and an accuracy of about 10% in the resulting line profiles is expected. Good agreement with experimental H_β profiles is obtained while there are deviations of factors of two with the usual Holtsmark theory. Asymptotic distributions for the line wings are given for astrophysical applications. Also here the electron effects are generally as important as the ion effects for all values of the electron density and in some cases the electron broadening is larger than the ion broadening. (auth)

4854

CONDUCTIVITY OF A WARM PLASMA. Lyman Mower (Univ. of New Hampshire, Durham and Massachusetts Inst. of Tech., Cambridge). *Phys. Rev.* **116**, 16-18(1959) Oct. 1.

A theory for obtaining the conductivity of a uniform plasma as a function of frequency and temperature is presented and compared with a number of recent treatments. (auth)

4855

THE MODEL C STELLARATOR FACILITY. Paper No. CP-59-1195. N. W. Mather, R. G. Mills, and J. G. Murray (Princeton Univ., N. J.). New York, American Inst. of Electrical Engineers, 1959. 19p. \$1.00.

The Stellarator (C) will utilize externally produced magnetic fields to confine a hot plasma. The d-c power supply for energizing the machine coils will consist of d-c generators with flywheel energy storage. A total pulse power of 204 Mw is to be available from 13 generators

which is sufficient power to create magnetic fields up to 55,000 gauss in the first Stellarator (C) design. The coils will be cooled by circulating chilled, deionized water. After initial breakdown of the hydrogenic gas in the stellarator, it will be heated by plasma current created and controlled by an ohmic heating supply, which will utilize 500,000 joules of capacitive energy storage. High-vacuum tubes will control the current which will be coupled to the plasma by means of special transformers. A plasma-current capability of 50,000 amp will be available with this equipment. Alternate or additional heating will be provided by means of r-f power sources. An r-f ringing equipment will generate 31 to 200 kc oscillating magnetic fields with peak values up to 12,000 gauss and coil currents of 200,000 amp or more. Capacitive energy storage and spark-gap switching are to be utilized. Also being designed is r-f equipment for ion cyclotron-resonance heating. The frequencies involved range from 7 to 40 mc. Power levels range up to 14 Mw of pulse power. (auth)

4856

IMPROVEMENTS IN OR RELATING TO GAS DISCHARGE APPARATUS FOR PRODUCING THERMONUCLEAR REACTIONS. George Paget Thomson and Moses Blackman (to United Kingdom Atomic Energy Authority). British Patent 822,462. Oct. 28, 1959.

A thermonuclear reactor is described which comprises a toroidal vessel made up of mutually insulated cylindrical sectors arranged in a circle. Potentials are applied sequentially to these sectors so that a traveling wave is produced to maintain and contain the reacting gas and raise it to energy levels where thermonuclear reactions occur. Calculations for a 130-cm circle of 30-cm cross section (volume 2500 l) with a space charge of 10^8 v and an electron density of $3 \times 10^{14}/\text{cc}$ reveal the following data: Deuteron temp. = 75 kv or $9 \times 10^8^\circ\text{C}$, mean time before disintegration = 100 sec, energy yield 13,000 kw for 600 kw input. (T.R.H.)

4857

IMPROVEMENTS RELATING TO THERMO-NUCLEAR APPARATUS. Jiri George Linhart (to British Thomson-Houston Co., Ltd.). British Patent 824,765. Dec. 2, 1959.

A thermonuclear reactor is described. A plasma is heated and contained in a torus by electric and magnetic fields. (T.R.H.)

Shielding Calculations

4858 ORNL-2882

Oak Ridge National Lab., Tenn.

ON THE DISK TO POINT OR INFINITE PLANE SHIELDING TRANSFORMATIONS. E. P. Blizard. Jan. 5, 1959. 12p. Contract W-7405-eng-26. OTS.

The detector readings to be expected from an infinite plane isotropic source in a uniform infinite medium are derived in terms of measurements at specific distances along the axis of a uniform isotropic disk source. Extrapolation of the higher terms in this series on the basis of exponential attenuation is described, and approximations are given for the remainder in this series. Another transformation is given which yields directly the point-to-point attenuation kernel in terms of a series of measurements on the axis of a plane isotropic disk source. Approximations based on the extrapolation of the data are also given to enable estimation of the remainder of the series. (auth)

4859

THE SHIELDING OF HELICAL DUCTS. C. C. Horton

(Rolls-Royce Ltd., Derby, Eng.). Nuclear Sci. and Eng. 6, 525-9(1959) Dec.

The problem of radiation penetration through a shield containing a helical duct is considered by representing the duct by successive straight ducts joined at a fixed angle. Expressions for the emergent radiation flux are derived and illustrated for a typical case. It is shown that, in a representative example, the contribution from radiation scattered along the duct is a small fraction of the general increase in radiation level due to the reduced effective density of the bulk shield in the vicinity of the helix. (auth)

4860

NOMOGRAMMY DLYA RASCHETA ZASHCHITY OT GAMMA-LUCHEI Ra, Co⁶⁰, Cs¹³⁷, i Ir¹⁹². (Nomograms for Computing Shielding Requirements Against Ra, Co⁶⁰, Cs¹³⁷, and Ir¹⁹² γ Rays). N. G. Gusev and E. E. Kovalev. Moscow, Publishing House of the Main Administration on Atomic Energy, Council of Ministers, 1959. 71p.

Forty-five nomograms are plotted for fast and accurate estimates of shielding against equilibrium and non-equilibrium decay products of radium, Co⁶⁰, Cs¹³⁷, and Ir¹⁹². The shielding materials are lead, iron, lead glass, concrete, and water. The nomograms are plotted for wide γ beams. Descriptions and instructions for use are given. The book is designed for engineers, medics, and other personnel handling γ emitting isotopes. (R.V.J.)

Theoretical Physics

4861

STATISTICAL DERIVATION OF THE QUANTIZED ENERGY OF RADIATION AND GAS. K. F. Novobátzky (Roland Eötvös Univ., Budapest). Acta Phys. Acad. Sci. Hung. 10, 407-19(1959). (In German)

It is established that quantization causes no break with classical theory, but was required by the Nernst theorem. The radiation law, the form of the radiation quantum, and the form of the gas energy results directly without special quantization assumptions. It is established that for radiation Boltzman statistics are authoritative. (tr-auth)

4862

SECOND-ORDER FOUR-COMPONENT WAVE EQUATION IN THE SYMMETRICAL THEORY, WITH PSEUDOSCALAR COUPLING. K. Ladányi (Hungarian Academy of Sciences, Budapest). Acta Phys. Acad. Sci. Hung. 10, 455-6(1959).

It has been shown that in the presence of an electromagnetic field the Dirac equation can be reduced to a second-order two-component equation, and second-order wave equations of fermion doublets for axial vector coupling have been introduced. A similar procedure is introduced for symmetrical pseudoscalar coupling. (J.S.R.)

4863

THE IMAGINARY PART OF THE OPTICAL MODEL POTENTIAL FOR NEUTRON INTERACTIONS WITH NUCLEI. Gordon L. Shaw (Cornell Univ., Ithaca, N. Y.). Ann. Phys. (N. Y.) 8, 509-50(1959) Dec.

The Brueckner nuclear many-body theory is modified so that it can be applied to the problem of dealing with quasi-stationary states such as low-energy neutron interactions with heavy nuclei taking into account the identity of the incident neutron with the nucleons in the nucleus. An expression for an optical model potential is obtained, and the imaginary part W is calculated. The results indicate a surface absorption potential: W , for a given incident neutron energy, has a constant central region and reaches

a peak > twice the central value in the surface region. An investigation is made of the next step after the compound state is formed. For heavy nuclei, compound nucleus formation dominates over compound elastic scattering. For light nuclei ($A < 50$), there may be fluctuations of the cross section related to two-particle states. (auth)

4864

ON THE INTERPRETATION OF ISOVECTOR COMPONENTS. J. Lukierski (Wrocław Univ., Poland). Bull. acad. polon. sci., Ser. sci., math., astron. et phys. 7, 577-81(1959). (In English)

Description of $\frac{1}{2}$ spin fields with the help of 4-spinors makes possible the introduction of the transformation group Λ' which commutes with the representations Λ of the 6-parameter proper Lorentz group. If $\kappa \neq 0$, $e = 0$, the corresponding neutrino equation was found to admit transformations in the (1,2,4)-subspace of the full isospace. In the general case, if $e, A_\mu \neq 0$, the Dirac equation permits only rotations in the (1,2)-isoplane. From these considerations it is shown that isotransformations can be interpreted arbitrarily in definition of charge and mass conjugation, which are allowed by the equation. It is shown that the isocomponents of tensors correspond to different transformation types with respect to inversions of space and time. (C.J.G.)

4865

THE METHOD OF QUASI-REAL PROCESSES IN QUANTUM ELECTRODYNAMICS. Paul Kessler and Francis Perrin. Compt. rend. 249, 2162-4(1959) Nov. 23. (In French)

A new computation procedure for Feynmann diagrams which contain a vertex corresponding to the scattering of an extremely relativistic fermion with emission of a virtual or real photon is described. This scattering is treated as a quasi-real process, and the formula giving the probability of the process is shown. (tr-auth)

4866

ON ADIABATIC INVARIANCE IN QUANTUM MECHANICS. Marius Kolsrud (Univ. of Oslo). Kgl. Norske Videnskab. Selskabs, Forh. 31, 26-33(1958). (In English)

A connection between quantum mechanical and classical adiabatic invariance is shown for the special case of a charged particle moving in a homogeneous, time-dependent magnetic field. The relationship consists of the fact that the transition probability between energy eigenstates corresponding to the magnetic field at two different times is a function of a certain classical adiabatic invariant alone. From this relation follows the well-known result that during sufficiently slow changes of the magnetic field the particle will remain in one quantum state which passes continuously through the different instantaneous energies. The adiabatic invariance of this classical quantity is shown directly by solving the equations of motion when the magnetic field changes linearly with time. (auth)

4867

THE DIRAC THEORY OF THE ELECTRON IN GENERAL RELATIVITY THEORY. O. Klein. Kgl. Norske Videnskab. Selskabs, Forh. 31, 47-51(1958). (In English)

The generally relativistic treatment of the Dirac theory is placed in a form suitable for extension to include meson-like charged fields. In order to introduce quantum theory at the beginning, the considerations are based on the invariant action integral multiplied by $i = \sqrt{-1}$. (J.S.R.)

4868

COLLECTIVE CO-ORDINATES FOR NUCLEAR ROTA-

TION. A. Bohr and B. R. Mottelson. *Kgl. Norske Videnskab. Selskabs, Forh.* 31, 71-9(1958). (In English)

The co-ordinate transformation leading to an approximate separation of the nuclear Hamiltonian into rotational and intrinsic parts is considered. It is found that the condition of optimum separation leads to an expression for the moment of inertia, equivalent to that of nucleons moving in an external rotating potential. For simplicity, the considerations are restricted to a two-dimensional system. (auth)

4869

LEVEL DENSITY OF A NUCLEON SYSTEM INTERACTING IN A SHELL. Roger Balian (Centre d'Études Nucléaires, Saclay, France). *Nuclear Phys.* 13, 594-620(1959) Nov. (2). (In French)

Using perturbation theory, the grand partition function is calculated for the completely degenerate system of interacting nucleons inside a shell. The level density is then derived by the Darwin-Fowler method. The purpose is to compare these results to exact levels known for a p-shell. The method gives fairly good results, even for a small number of particles, provided that the self-consistent field is taken into account, and the calculation is carried out in a coherent way; there is no advantage in performing the saddle point method after integration of the level density. (auth)

4870

A NEW METHOD IN THE THEORY OF SUPERCONDUCTIVITY. N. N. Bogolyubov (Bogoliubov), V. V. Talmachev, and D. V. Shirkov. Translated from Russian. New York, Consultants Bureau, Inc., 1959. 124p.

The present work is an extension of a new method in the theory of superconductivity. The energy of the superconducting ground state using Fröhlich's Hamiltonian, as well as the one-fermion and collective elementary excited states is calculated. It is shown in this way that the final formulas recently obtained by Bardeen, Cooper, and Schrieffer for the ground state and the one-fermion excited states are correct in the first approximation. The physical picture of the phenomenon is found in some ways to resemble more closely that described by Schafroth, Butler, and Blatt. The role of the Coulomb interaction between the electrons in the theory of superconductivity is analyzed. A system of fermions is treated with a fourth-order interaction Hamiltonian and establish the criterion for its superconductivity. (auth)

4871

CERTAIN PROBLEMS OF THE QUANTUM FIELD THEORY. N. N. Bogolyubov and D. V. Shirkov. p.514-21 of "Trudy Tret'ego Vsesoyuznogo Matematicheskogo S'ezda, Moscow, June-July, 1956, Vol. III." Moscow, Akademii Nauk SSSR, 1958. 599p. (In Russian)

Certain problems in quantum field theory are reviewed, and a comprehensive study is made of the group renormalization method. (R.V.J.)

4872

RADIOAKTIVNYE PREVRASHCHENIYA YADER I ATOMNAYA OBOLOCHKA. (Radioactive Transmutation of Nuclei and Atomic Shell). Tashkent, Tashkent Publishing House of the Academy of Sciences, Uzbek SSR, 1958. 498p.

Studies are made of radioactive transmutations with special attention to atomic shell participation in the transformation processes. Methods of experimental studies directly related to the shell (electron capture and γ conversion) are discussed as well as the effects of

shells on lifetime, energy spectra, and angular correlations of nuclear emissions. Recoil atom spectrometry, correlation of escape directions, and particle polarization in β transmutation are studied in relation to neutrino and β interaction problems. Secondary effects in β decay (internal bremsstrahlung, pair production, etc.) are discussed as well as the theoretical and experimental data on excitation and ionization of atoms and molecules in radioactive transmutation. Methods of isotopic and isomeric segregation and enrichment by means of kinetic and electron "activation" of recoil atoms are described. (R.V.J.)

REACTOR TECHNOLOGY

General and Miscellaneous

4873 CF-58-7-47

Oak Ridge National Lab., Tenn.
COMMENTS ON GCR FUEL ELEMENT DESIGN. W. T. Furgerson. July 10, 1958. 10p. OTS.

Criteria are presented in an effort to develop a basis for judging fuel element shapes for gas cooled reactors. Included are discussions of fabricability, surface to volume ratio, structural suitability, internal and external thermal paths, and thermal stability of structure. Diagrams of various configurations are also included along with a numbered comparison of the merits of each. (J.R.D.)

4874 HW-58743

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
EXPERIMENTAL PRTR MODERATOR FLOW DISTRIBUTION RESULTS. M. R. Kreiter. Jan. 7, 1959. 13p. OTS.

Results are reported of tests of the moderator flow distribution within a full-scale PRTR calandria mockup employing non-heated light water as the test fluid. The effect of three different orifice patterns upon the flow distribution was studied. From the data obtained, it was concluded that a pattern of $\frac{1}{2}$ inch orifices would provide mixing with a minimum of surface disturbance. (W.L.H.)

4875 HW-60899

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
REACTOR PIPING SEAL TESTING AND REACTOR PIPING STRUCTURAL INTEGRITY. Final Report on Design Tests PR-50 and PR-51. P. M. Jackson. June 26, 1959. 62p. Contract W-31-109-Eng-52. OTS.

A test program was conducted to develop high integrity piping and seal components for Plutonium Recycle Test Reactor installation. Methods of preventing leakage of D_2O coolant and maintaining operational safety were investigated. To find the most suitable seals and determine their leakage properties, a complete thermal cycling of prototype assemblies was conducted. Spiral-wound, stainless steel gaskets with asbestos filler were selected for all water seals. Gas seals were most effective with copper-jacketed, asbestos-filled gaskets, or those of solid copper. Jumper stresses developed by thermal expansion were investigated and came within ASA piping code requirements. Jumpers were flexed, about twice the distance expected on the reactor, at ambient and 500 to 530°F temperatures. The 37-degree, flare-fitted jumper connections proved quite acceptable during all tests. The disadvantage of the flare fittings was the large tightening torques required. (auth)

4876 IDO-16539

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

QUARTERLY PROGRESS REPORT [FOR] JANUARY, FEBRUARY, MARCH 1959. J. A. Norberg, ed. Nov. 20, 1959. 68p. Contract AT(10-1)-205. OTS.

SPERT I. In order to determine the effect on reactor shutdown of heat transfer to the moderator, a series of experiments were performed in the SPERT I reactor using insulated Type A fuel assemblies. Three heat transfer conditions were investigated: (1) boiling temperatures not attained prior to reactor self-shutdown, (2) boiling temperatures existent throughout the tests, and (3) boiling temperatures attained prior to shutdown for an uninsulated core, but not for the insulated core. Comparison of the results of the insulated core experiments with previous A-core data revealed no difference in behavior. The need for detailed studies of spontaneous shutdown mechanisms stimulated a series of capsule-type experiments designed to measure moderator expulsion and radiolytic gas formation during a reactor excursion. Temperature and void coefficient calculations for the SPERT I B-12/64 core have been made and are in essential agreement with available experimental results. A tabulation of the 20°C step-transient test data for the P-18/19 core has been completed. **SPERT II.** A calculation has been made to determine the excess reactivity of a proposed Al-H₂O, 8-plate modified B-type core at the operational conditions of 400 psig and 400°F. The results indicate that alternate plate loadings of 7 grams per plate and 17 grams per plate of U²³⁵, respectively, are sufficient to attain the 2% excess reactivity required for kinetic experiments. **SPERT III.** The initial cold critical experiments with the 27-assembly loading was repeated and additional cold critical experiments were performed with successively larger loadings through a 48-assembly core. A total of 11 different loadings was investigated. Hot critical experiments were commenced with the 48-assembly loading. Operating experience gained during the initial hot experiments and subsequent pressure operation has led to a number of component modifications. **Theoretical.** The way in which the compensated reactivity at the time of peak power versus reciprocal period depends on reactor properties has been determined analytically. The shape of this curve is a function of delayed neutron distribution, the prompt neutron lifetime and the shape of the transient power burst. A minimum in the curve turns out to be a non-essential characteristic for some practical cases. The results of this analysis may be used to incorporate the effects of delayed neutrons in the predictions of peak power and energy in the long period region. A variable reactivity coefficient having a positive or zero initial value at power levels below the operating level of a reactor and becoming negative above the operating level will allow a much lower investment in flexible k than that required for a reactor having a strong negative coefficient. The effect of such a reactivity coefficient on self-limiting power bursts has been investigated analytically for a simple case in terms of previously considered energy models and it appears that a positive or zero initial reactivity coefficient can result in an over-all gain in reactor safety. System requirements in terms of maximum allowable energy have been determined. The analysis may be extended to other systems. **Engineering.** Corrosion and galling of threaded fasteners used in reactor internal structures under high temperature (650°F) demineralized water service has initiated an investigation to determine more suitable materials. Warping and blistering of P-18/19 core fuel assembly plates has prompted a metallurgical

investigation to determine the extent of damage and possible cause of the failure. Fuel and cladding temperatures and heat transfer rates for a 5 msec transient test were calculated. Center-line meat temperatures were shown to reach approximately 1500°F with peak heat fluxes of 1.1×10^7 Btu/(hr)(ft²). Construction of the facility is estimated at 80% completed. Reactor components are being modified, based on SPERT III experience, with design and fabrication estimated at 90% complete. Fuel assembly fabrication problems have been solved and procurement is expected to meet the revised schedule. A manual of detailed heavy water handling procedures based on maintaining isotopic purity, minimizing losses and essentially clean operations is in preparation. Equipment malfunctions and operational difficulties have been experienced in the control rod drive units, reactor control system, internal structure galling, primary system leakage, primary system valves, and general plant instrumentation. Corrective action has been initiated to preclude future difficulties. (For preceding period see IDO-16537.) (auth)

4877 KAPL-M-SMS-98

Knolls Atomic Power Lab., Schenectady, N. Y. MECHANISMS OF REACTOR SYSTEM ACTIVATION. S. Yerazunis, E. H. Alkire, and R. L. Seidel. May 27, 1959. 69p. Contract W-31-109-Eng-52. OTS.

A theory is presented of reactor system activation by corrosion products reflecting molecular and particular transport of activities originating from in-flux corrosion product deposits. A digital computer code capable of solving the differential equations describing the activity build-up process is given. The method was applied to the KAPL-37 test facility and the S3G Reactor. (W.D.M.)

4878 NAA-SR-3708

Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.

NUCLEAR REACTOR SIMULATION BY ANALOG COMPUTER. A LITERATURE SURVEY. R. J. Allen, F. G. Bennett, IV, and R. N. Cordy. Dec. 15, 1959. 66p. Contract AT-11-1-GEN-8. OTS.

A bibliography covering the years 1953 through 1958 on nuclear reactor simulation by analog computers is presented. References are given to report and journal literature. An author index is included. (W.D.M.)

4879 NAA-SR-3989

Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.

GAMMA-RAY AND FAST NEUTRON ANNULAR STREAMING EVALUATION THROUGH SODIUM REACTOR EXPERIMENT (SRE)—MARK II CONTROL AND SAFETY ROD ASSEMBLIES. F. D. Anderson. Oct. 15, 1959. 30p. Contract AT-11-1-GEN-8. OTS.

An experimental program was initiated to determine the extent of fast neutron and gamma ray streaming through the SRE Mark II control and safety rods and to evaluate the adequacy of the shielding provided in these control and safety rods. The methods and procedures used to evaluate these problems are routine and proven for determining gamma-ray and fast neutron dosages using radiation sensitive films and gold foils. The final experimental results indicated that no excessive streaming of either gamma rays or fast neutrons is present above or around the SRE Mark II control and safety rods. The analytical attenuation methods used to calculate the fast neutron and gamma-ray streaming dose rates gave results that compared favorably with the experimental data. Even though the agreement was favorable, it cannot be concluded that these analytical methods would be equally valid for other annular geome-

tries. Additional experimental work will be necessary in order to establish the validity for performing similar analysis, but the favorable agreement encourages the use of such methods until other methods are determined. (auth)

4880 NAA-SR-4488

Atomics International Div., North American Aviation, Inc.,
Canoga Park, Calif.

SRE FUEL ELEMENT DAMAGE. Interim Report. A. A. Jarrett, ed. Nov. 30, 1959. 181p. Contract AT-11-1-GEN-8. OTS.

During the course of power run 14 on the Sodium Reactor Experiment (SRE) at low power, the temperature difference among various fuel channels was found to be undesirably high. Normal operating practices did not succeed in reducing this temperature difference to acceptable values and on July 26, 1959, the run was terminated. A series of fuel element inspections was begun to ascertain the cause of these circumstances, and several fuel elements were discovered to have suffered substantial damage. On July 29, 1959, an Ad Hoc Committee was appointed by Atomics International to assist in the analysis of the existing situation in the reactor and the determination of its origin. During the three-month period since the termination of power run 14, there has been a very active program of investigation. The data accumulated during the operation of the SRE have been re-examined and evaluated. Metallurgical examination was made of a few samples of the fuel and other components of the reactor where possible. Some chemical analysis was made of the coolant and its contaminants. Radiochemical analyses have been made of the coolant and gaseous activity. Reactivity effects were investigated. Some experimental programs were initiated to examine mechanisms of damage and potential deleterious effects on the reactor system. Tentative conclusions, based on data obtained to date by the current investigation into the causes of the fuel element damage, may be summarized as follows: (1) The fuel cladding failed as a result of the formation of low-melting iron-uranium alloy which was produced because of partial blockage of some of the coolant passages and local overheating of the fuel elements. Coolant channel blockage was initiated by accumulation of the decomposition products of tetralin which had leaked into the primary system. Sodium oxide and sodium hydride may have contributed to this situation. (2) The high temperature runs on SRE bear no relation to the cladding failure of run 14. (3) While several possible explanations have been suggested for the reactivity changes incurred during run 14, no definitive conclusions are as yet available. (4) The extent of possible surface damage to the components of the primary system by carburization, nitriding or hydriding is not yet known. It is anticipated, however, that damage has been sustained by fuel cladding (known), moderator cans (probable), and the intermediate heat exchanger (just possible). (5) In spite of the cladding failure to at least 11 of the fuel elements, no radiological hazard was present on the reactor environs. (auth)

4881 NAA-SR-Memo-3538

Atomics International Div., North American Aviation, Inc.,
Canoga Park, Calif.

NUCLEAR CALCULATIONS FOR XYLENE MODERATED OMRE CORE. B. Moskowitz. Feb. 18, 1959. 6p. OTS.

It is proposed that the OMRE first loading core be rinsed with xylene. The change in multiplication and rod worth under this condition was calculated. An estimate was made of the number of fuel elements to be withdrawn from the core for a safe assembly. The multiplication of the OMRE first loading core immersed in p-xylene was computed to

be $k_{eff} = 1.09$. The computational method gives $k_{eff} = 1.05$ for OM-terphenyl. Therefore, the grain in multiplication is $1.09 - 1.05 = 0.04$. Rod worth decreases by 6.5%, from $k = 0.16$ to $k = 0.15$. (W.L.H.)

4882 NDA-84-22

Nuclear Development Corp. of America, White Plains,
N. Y.

5 MW, SODIUM DEUTERIUM REACTOR EXPERIMENT—
DESIGN REPORT. S. Davis, comp. June 26, 1959. 37p.
Project II. Contract AT(30-1)-2303. OTS.

A conceptual design is presented for a 5 Mw(th) 3 row, 31 lattice tube low cost Sodium Deuterium Reactor Experiment (SDRE) with a fixed center (12 in. diam.) through hole and 10 (5 in. diam.) peripheral experiment through holes. Preliminary designs were evaluated on the basis of capital cost, experimental value, and safety. The SDRE is a slightly enriched, sodium-cooled, D_2O moderated reactor having a design configuration similar to the 10 Mw(e) Sodium Deuterium Reactor. (W.D.M.)

4883 PB-161010

Fluor Corp., Ltd., Whittier, Calif.

PRELIMINARY DESIGN STUDY OF AN OPTIMUM NUCLEAR REACTOR-SALINE WATER EVAPORATOR PROCESS. Research and Development Progress Report No. 34. 1959. 234p. OTS.

An engineering design study was made of a 50×10^6 gallons/day sea water conversion plant employing a multi-stage flash evaporator and a light water-moderated and cooled nuclear steam generator. It was necessary to select the optimum 370 Mw(th) reactor and to select the optimum capacity multi-stage flash evaporator that when combined with the optimum reactor system would produce fresh water at the least total cost. A preliminary design of a 1×10^6 gallons/day pilot plant was also prepared. The cost of potable water produced from sea water in a 5×10^6 gallons/day 52-stage flash evaporator is estimated to be \$0.42 per 1000 gallons. This estimated cost includes all costs associated with the operation of the plant. (W.D.M.)

4884 WAPD-TM-128

Westinghouse Electric Corp. Bettis Atomic Power Lab.,
Pittsburgh.

TEMPERATURE COEFFICIENTS OF A HIGHLY ENRICHED CORE IN SLAB GEOMETRY. S. L. Shufler, W. F. Vogelsang, R. S. Wick, and H. I. Dolnick. Oct. 1959. 30p. Contract AT-11-1-GEN-14. OTS.

A prime factor in achieving a successful nuclear design for a critical assembly is an accurate estimate of the magnitude and rate of change of the temperature coefficient of reactivity. Such a calculation is complicated by the many sensitive temperature dependent factors competing simultaneously—such as cross sections, core expansion, and radial and axial leakages. Three calculational techniques for computing the temperature coefficient of a highly enriched core in slab geometry between 20 and 90°C combine one- and two-dimensional diffusion theory codes with a two-group model to simulate the over-all three-dimensional temperature effects; the calculated results compare closely with measurements. (auth)

4885

HEALTH PHYSICS PROBLEMS FOLLOWING A REACTOR ACCIDENT. J. M. White (Atomic Energy of Canada, Chalk River, Ont.). *Am. Ind. Hyg. Assoc. J.* 20, 478-81(1959) Dec.

The NRU reactor accident of May 1958 is reviewed. Health physics problems following the accident are discussed. Recommendations are included for additional

equipment which would be useful during accidents of this kind. (C.H.)

4855

AN ANALOGUE DEVICE FOR DETERMINATION OF BUCKLING. Teuvo Kohonen and Osmo Ivanto. *Ann. Acad. Sci. Fennicae Ser. A VI*, No. 14, 1-13(1958).

Starting from the one-group approximation of a bare thermal reactor, an analogue device was designed, by means of which the geometric buckling of a cylindrical reactor of an arbitrary cross section can be determined. The system consists of a vibrating membrane, the resonance frequency of which is measured. The boundary conditions at the control rods, which are assumed to be completely "black" to thermal neutrons, are simulated by equivalent fixed areas of the membrane. The model developed seems to be suitable for informatory calculations of control rod effectiveness, especially for complicated cross sections. An accuracy of 1% is achievable. (auth)

4887

THE INFLUENCE OF RADIOACTIVE DECAY ENERGY OF FISSION PRODUCTS ON THE AUTOMATIC CONTROL OF NUCLEAR POWER PLANTS. Erkki Laurila. *Ann. Acad. Sci. Fennicae Ser. A VI*, No. 30, 1-7(1959).

A simple transfer function representation for radioactive beta- and gamma-decay power in reactors is described. The role of this power appears to be of little importance in automatic control problems. (auth)

4888

CALCULATION OF FAST NEUTRON MULTIPLICATION IN THICK FUEL ELEMENTS. K. O. Thielheim (Universität, Kiel). *Atomkernenergie* 4, 429-37(1959) Nov. (In German)

A method is presented for calculating fast neutron multiplication in thick fuel elements. Both change of collision probability in succeeding neutron collision generations and degradation of neutron energy by inelastic scattering are considered. In thin fuel elements these factors have generally no influence on neutron multiplication. Collision probabilities in plane and spherical geometry have been evaluated numerically on an IBM 704 digital computer and are presented. The influence of inelastic scattering is determined through the method of "neutron classes" which are defined according to the multiplicity of inelastic scattering. Results of this method show that energy degradation by inelastic scattering may have a nonnegligible effect on fast neutron multiplication in thick fuel elements. Comparison is made between methods, showing the feasibility of the transport theoretical method. (auth)

4889

ON THE CALCULATION OF THE THERMAL UTILIZATION FACTOR OF A LATTICE CELL. M. Angelopoulos. *Atomkernenergie* 4, 437-42(1959) Nov. (In English)

For the calculation of the thermal utilization factor of a lattice cell with a bare fuel element, the knowledge of the "disadvantage factor," Φ_1/Φ_0 , is essential. The original calculations of the neutron flux distribution in a cell and hence of the disadvantage factor, were carried out on the assumption that diffusion theory could be applied both in the fuel rod and the moderator with approximations. A multiple collision method based on transport theory for the calculation of the flux distribution within an absorbing medium has been applied to the region within the fuel element, elementary diffusion theory being used only within the moderator. Calculations are carried out for a number of natural uranium rod and air channel diameters, at two pitches. The results, together with those from Newmarch's

and Amouyal's method using the same data, are compared with experimental measurements. (auth)

4890

CALCULATION OF TEMPERATURE AND MECHANICAL STRESS IN SHIELDS. E. Schröder (Deutsche Babcock and Wilcox-Dampfkesselwerke AG, Oberhausen, Ger.). *Atomkernenergie* 4, 442-5(1959) Nov. (In German)

Thermal neutron capture energy is released in the form of gamma rays. These gammas are absorbed and produce heat. The temperature- and stress-distribution in shields caused by this process is discussed. (auth)

4891

RESULTS AND PROBLEMS OF REACTOR GRAPHITE DEVELOPMENT IN GERMANY. E. Fitzer, M. Beutell, E. Nedopil, and K. W. F. Etzel (Simens-Planierwerke AG für Kohlefabrikate, Meitingen, Ger. and Farbwerke Hoechst, Frankfurt am Main). *Atomkernenergie* 4, 449-55(1959) Nov. (In German)

A review is given of evolution and present position of graphite reactor development in the German Federal Republic. The properties of electrographite being developed in Germany for use in reactors are discussed in detail. As a result of steady research on a large scale the user was given a fine grained product with high quality structure, high volume weight, conductivity for heat and electricity being extremely good and the thermal coefficient of expansion being low. Purity was up to 99,999% pure carbon. Those problems in reactor graphite development are referred to, which could not be solved so far because of more strict limitation of conditions of application. (auth)

4892

EXACT SOLUTION OF THE REACTOR KINETICS EQUATIONS FOR LINEAR, EXPONENTIAL, OR RECIPROCAL REACTIVITY DEPENDENCE ON TIME. Henri B. Smets (Massachusetts Inst. of Tech., Cambridge and Brookhaven National Lab., Upton, N. Y.). *Bull. classe sci., Acad. roy. Belg.* (5) 45, 256-71(1959). (In English)

The general equations for reactor dynamics at low power are integrated by means of Laplace type integrals for the three cases of linear, exponential, or reciprocal (1/t) reactivity variation. In the first and second case, the exact solution can be written under the form of the generalized function of the parabolic cylinder and the Meijer G function, respectively. When the effect of the delayed neutrons is represented by a single equivalent group, the solution in the third case can be expressed by means of the confluent hypergeometric function. (tr-auth)

4893

CONDITIONING OF D₂O IN HEAVY WATER POWER REACTORS. G. M. Allison (Atomic Energy of Canada Ltd., Chalk River, Ont.). *Can. J. Chem. Eng.* 36, 217-20(1958) Oct.

The problems associated with the maintenance of purity of the D₂O in a pressurized heavy water power reactor are indicated and the handling of these problems is discussed. Results from experimental work indicate that the reactor should be operated with the coolant at a high pH to minimize the corrosion problems. Continuous side-stream purification with mixed-bed ion exchange resin columns is desirable. Some means of upgrading D₂O is desirable for heavy water reactors for intermittent or continuous use. (W.D.M.)

4894

NUCLEAR POWER DEVELOPMENT IN CANADA. M. H. Thomas (Atomic Energy of Canada Ltd., Chalk River, Ont.). *Eng. J. (Montreal)* 4p.(1958) Oct.

A brief history of the Canadian nuclear program is given and the development of power from nuclear energy on a large scale is reviewed. The Canadian scientists and engineers are primarily concerned with economic base load stations designed to meet the particular needs of Canada. (W.D.M.)

4895

THE OCCURRENCE AND CONTROL OF SPATIAL INSTABILITIES IN LARGE REACTORS. R. L. Carstairs and R. W. Taylor. G.E.C. Atomic Energy Rev. 2, 89-97 (1959) Sept.

The reasons for the possible occurrence of regional instabilities in large reactor cores are discussed. A review of the basic behavior and control concepts of a reactor is given, and the techniques of analysis available to describe the spatial effects are considered. These techniques are illustrated with a review of a modal analysis of radial and azimuthal core behavior, involving the use of a large analogue computer. The importance of a suitable reactor control system is emphasized. In general, analyses show that instabilities can occur, but they are of relatively long-term time behavior and can easily be controlled using existing techniques. (auth)

4896

THE METHOD OF HEAT EXCHANGE IN A HOMOGENEOUS BOILING ATOM REACTOR. Ya. Malak and I. Samid (Inst. of Nuclear Studies, Czechoslovak Academy of Sciences, Prague). Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R. 2, No. 9, 12-23(1959) Sept. (In Russian)

A method is presented for the measurement and analysis of experimental results in investigations of the thermokinetics of volume boiling. The method is tested for the case in which specific power is given by the expression: $q_s = q(1 - \phi)$. In studying volume boiling it is essential to accumulate additional information on the velocity of steam in a steam heating mixture, on the coefficient of heat exchange from water to steam, and on the specific surface of separation of phases. On the basis of a rough approximate calculation it will be necessary to check conditions of the method for the case when the specific power relationship corresponds more closely to conditions in a homogeneous boiling reactor. (auth)

4897

SOME ENGINEERING DEVELOPMENTS IN THE NUCLEAR POWER FIELD. A. T. Bowden (C. A. Parsons and Co., Ltd., Newcastle-upon-Tyne, Eng.). J. Joint Panel Nuclear Marine Propulsion 3, 34-48(1959) Oct.

Problems in the design and construction of nuclear power stations are discussed. Engineering developments in fuel elements, pressure vessels, gas circulating systems, and circulators are reviewed. (C.J.G.)

4898

ERRORS IN REACTIVITY MEASUREMENTS DUE TO PHOTONEUTRON EFFECTS. Charles Erwin Cohn (Argonne National Lab., Lemont, Ill.). Nuclear Sci. and Eng. 6, 284-7(1959) Oct.

In reactors having D_2O or Be moderators, the photoneutrons produced by gamma rays from long-lived fission products give rise to transient effects which could introduce appreciable errors into various types of reactivity measurements. Digital computer calculations of these effects in D_2O are presented for criticality measurements, subcritical multiplication measurements, rod drops, and rising period measurements. It is found that in some cases appreciable errors are possible even after one hour waiting periods. Since the Be photoneutron data cannot be resolved into groups, calculations for Be could not be done.

However, the nature of the effects that could be expected is discussed. (auth)

4899

FLUX PERTURBATION PRODUCED BY ION CHAMBERS AND FISSION CHAMBERS. Alain Sola and William W. Managan (Argonne National Lab., Lemont, Ill.). Nuclear Sci. and Eng. 6, 294-7(1959) Oct.

When flux measurements are made in reactors or in piles, large ion chambers are commonly used. The current output of these chambers is read in terms of flux. The chambers depress the flux, however, and a correction should be applied to get the value of the unperturbed flux. The flux perturbation was measured in a large graphite diffusing medium and found to be between 5 and 25% when measured on the outer surface of typical ion chambers. At about 10 in. from the end of the chamber the perturbation was no longer observed. The flux was measured with a small fission counter which did not depress the flux appreciably. To measure the flux depression inside an ion chamber, the latter was simulated by stacking boron-coated aluminum plates above and below the small fission counter used previously. The measurement of the flux depression was found to be in good agreement with that which can be estimated from a calculation in which an exponential absorption is assumed. From these experiments it is concluded that the value of the flux measured with a large boron coated ion chamber gives an estimation of the flux within 20 to 50% of the unperturbed value depending on the amount of boron in the chamber, while the estimation of the flux is within 5 to 15% when measured with a large U^{235} -coated fission counter. It should be noted that, although these results apply in a graphite diffusing medium, they do not necessarily apply in an absorbing medium such as the heavy concrete which usually surrounds the instrument holes in reactors. (auth)

4900

CALCULATIONS OF FLUX DISTRIBUTIONS IN A BOILING WATER REACTOR. Y. Fukai, A. Shimizu, and S. Miyamoto (Nippon Atomic Industry Group Co., Ltd., Tokyo). Nuclear Sci. and Eng. 6, 298-305(1959) Oct.

The distributions of neutron flux and void in an orificed core of a boiling water reactor are calculated analytically by use of the relation between void generation and power. The analytical method is described, and it is shown that comprehensive surveys of the nuclear and heat performance of a boiling water reactor are possible with little effort. As an example, the technique of making the void map is shown. An alternate method for this problem is also described. (auth)

4901

MEASURING THE RELEASE TIME AND TOTAL DROP TIME OF A CONTROL ROD. Charles Zucker and Lewis Haring (Foster Wheeler Corp., New York). Nuclear Sci. and Eng. 6, 328-32(1959) Oct.

A method for measuring the total drop time and release time of a control rod is presented. The application of these measurements to the determination of specific reactor control characteristics is discussed. Experimental values for several control rods are reported. (auth)

4902

THE APPLICATION OF TOPOLOGICAL METHODS TO THE KINETICS OF HOMOGENEOUS REACTORS. Henri B. Smets and Elias P. Gyftopoulos (Massachusetts Inst. of Tech., Cambridge). Nuclear Sci. and Eng. 6, 341-9(1959) Oct.

The step and ramp responses of homogeneous reactors with a single negative temperature coefficient of reactivity

and delayed neutrons are studied by means of topological methods. The properties of stability in the small and in the large are derived for the first time and particular solutions are found. An approximate analytical solution is also proposed in the case of no heat losses (adiabatic reactor model) and small or large reactivity variation. (auth)

4903

ANALYSIS OF THE ZERO POWER REACTOR TRANSFER FUNCTION. H. C. Corben (Ramo-Wooldridge, Los Angeles). *Nuclear Sci. and Eng.* **6**, 461-5(1959) Dec.

Algebraic expressions for the amplitude and phase of the zero power transfer function allow these quantities to be evaluated from measured precursor data without the use of a digital computer. The asymptotic forms of the amplitude and phase for large and small values of ω are particularly simple. The expressions show the conditions under which the gain should be frequency-independent and yield a simple formula for the angular frequency ω_0 at which the phase angle reaches a maximum. The inhour relation is shown to be intimately related to the transfer function, the reactivity in dollars for any period α^{-1} less than one second being equal to $1 - \tan \epsilon$, where ϵ is the phase angle at $\omega = \alpha$. The value of α corresponding to prompt critical is shown to be always equal to ω_0 . (auth)

4904

FISSION FRAGMENT IMPACT TRAPPING BY ThO_2 SLURRY PARTICLES. Donald G. Gardner (Westinghouse Electric Corp., Pittsburgh). *Nuclear Sci. and Eng.* **6**, 487-92(1959) Dec.

Assuming a uniform distribution of ThO_2 slurry particles suspended in an aqueous medium, the probability of a recoil fission fragment escaping the parent slurry particle and then coming to rest within another slurry particle was estimated. The results indicate that for the slurry particle diameters and volume concentrations that may be expected in certain homogeneous reactor systems only a small percentage of the fission fragments will end their range within slurry particles. The theoretical predictions compare favorably with experimental results from a U-O aqueous slurry system. (auth)

4905

MATERIAL BUCKLING MEASUREMENTS IN A SUBCRITICAL ASSEMBLY. Robert E. Uhrig (Iowa State Univ. of Sciences and Tech., Ames). *Nuclear Sci. and Eng.* **6**, 530-2 (1959) Dec.

An alternate method of measuring material buckling in a subcritical assembly is presented. The fundamental mode of the neutron flux is isolated by using the orthogonality introduced when the equation for the neutron flux in a subcritical assembly is multiplied by $[\cos \pi x/a \cos \pi y/b \, dx \, dy]$ and integrated over the cross-sectional area of the assembly. The resulting double integral is evaluated by measuring the neutron flux at grid points and then employing tabular integration. After neutron flux measurements were taken on two levels, the inverse relaxation length and material buckling can be evaluated. The precision of these determinations are obtained by using the method of propagation of precision indices. (auth)

4906

NUCLEAR REACTOR KINETICS SIMULATOR. Wiesław Filipczak and Majer Sztajnkoier (Instytut Badań Jądrowych PAN, Warsaw). *Nukleonika* **4**, 395-404(1959). (In Polish)

The design of a simple reactor kinetics simulator is presented. The equations for the device may be solved in real time or expanded by a factor of 5. A potentiometer

varies the effective multiplication factor over the range -10 to $+1\% \delta k$. An MDM operational amplifier is used with a gain factor of 3×10^6 , including phase inverter loop. The phase inverter, used in conjunction with a d-c amplifier, has a gain of 1800. The simulator is operated over three decades at 0.05 to 50 v. (C.J.G.)

4907

ECONOMICS OF URANIUM AND THORIUM FOR THE GENERATION OF ELECTRICITY. W. B. Lewis (Atomic Energy of Canada Ltd., Chalk River, Ont.).

Within the next 25 years in prosperous industrial areas new electric generating capacity amounting to more than three times all existing capacity will be built. Nuclear power will become competitive with progressively cheaper alternatives. Allowing for the cost of nuclear reactors, fueling must be cheaper than in conventional thermal plants. Too low a burn-up yield from uranium would prevent this. Too high a burn-up would reduce the uranium needed. Such high burn-up would, however, require a very large nuclear power industry first, so it happens that there is no conflict between the uranium mines and the nuclear power industry in seeking an overall burn-up of 0.5 to 3% and the higher the better for prosperity in all aspects. Burn-up of 1% is in prospect from natural uranium heavy-water-moderated reactors. A make-up supply of 12,000 tons of uranium per year would support 100 million kilowatts capacity. More is required for the expanding inventory. Thorium contains no fissile nucleus, so systems based on it require uranium also. In the long term, thorium may become the major source of nuclear power; speculative forecasts of how this may come about are presented. (auth)

4908

ATOMKERNPROZESSE DER SPALTUNGSREAKTOREN. (Nuclear Processes of Fission Reactors). Heinz Schlechtweg. Stuttgart, Wissenschaftliche Verlagsgesellschaft m.b.H., 1959. 214p.

An introduction to the physical processes which occur in nuclear reactors is presented. The book is intended not only for students, but for physicists and engineers in the reactor field. Advances announced at the 1958 Geneva Conference for the Peaceful Application of Nuclear Energy are included. The subjects discussed are characteristics of neutron structure, mechanisms of nuclear reactions, neutron reactions other than fission, and nuclear fission. (J.S.R.)

4909

YADERNYE REAKTORY. (Nuclear Reactors). E. M. Balabanov. Moscow, Publishing House of the Ministry of Defense, USSR, 1957. 211p.

The design, performance, and uses of various types of reactors are described. (R.V.J.)

4910

IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. John Winton and Lawrence Henry Cope (to United Kingdom Atomic Energy Authority). British Patent 818,193. Aug. 12, 1959.

A fuel element design for "spiking" a reactor or increasing reactivity at some places is described. It consists of Pu oxides encased in graphite in several configurations. (T.R.H.)

4911

IMPROVEMENTS IN FISSIONABLE MATERIALS FOR USE IN NUCLEAR REACTORS AND IN THE METHODS OF MANUFACTURING SUCH MATERIALS. Marcel Englander and Jacques André Stohr (to Commissariat

à l'Énergie Atomique). British Patent 821,639. Oct. 14, 1959.

A reactor fuel alloy composition and method of preparation are offered. In one example a 50-kg U billet is provided with a recess in which 0.4 wt. % Al and 0.15 wt. % Zr are placed. The billet is vacuum-melted and heated to 1500°C for 30 to 45 min and then poured into molds. The cast product is heat treated 50 hr at 1050°C and quenched. Final vacuum heating at 600°C for 10 min gives a metal with a Vickers hardness of 420 and is resistant to thermal fatigue. The Zr addition permits the reduced time and temperature during heat treatment. (T.R.H.)

4912

IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Roy Jackson Smith (to General Electric Co., Ltd.). British Patent 822,415. Oct. 28, 1959.

A nuclear power plant control scheme is offered in which reactor temperature is maintained constant by regulation of neutron flux and coolant flow. The two signals for these regulations are adjusted with respect to one another by a manually operated trimmer control. This is accomplished by a pair of ganged potentiometers and a flux-flow recorder. Thus power output is adjusted in accord with power demand. (T.R.H.)

4913

NUCLEAR REACTORS. Campbell Dean Boadle (to United Kingdom Atomic Energy Authority). British Patent 822,461. Oct. 28, 1959.

A gas-cooled reactor with refractory pellet fuel is described. In particular, the invention offered consists of a coolant duct arrangement. (T.R.H.)

4914

FUEL ELEMENTS FOR NUCLEAR REACTORS. (to Physikalische Studiengesellschaft Düsseldorf m.b.H.). British Patent 822,629. Oct. 28, 1959.

The use of Pu compounds such as oxides, silicides, carbides, and nitrides as reactor fuel material is suggested to offset health hazards and mechanical strength deficiencies. (T.R.H.)

4915

IMPROVEMENTS IN PILES OF MODERATOR AND/OR REFLECTOR ELEMENTS FOR NUCLEAR REACTORS. (to Commissariat A l'Énergie Atomique). British Patent 822,788. Oct. 28, 1959.

A method of arranging moderator or reflector blocks is described. The blocks are stacked in layers running alternately in opposite directions to allow for dimensional changes during reactor operation. A key-slot arrangement for guides during stacking is also provided. (T.R.H.)

4916

IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR FUEL ELEMENT ASSEMBLIES AND METHODS OF MANUFACTURING THE SAME. (to Westinghouse Electric International Co.). British Patent 822,790. Oct. 28, 1959.

A stainless steel PWR fuel element and its manufacture are described. A number of stainless steel rods containing UO_2 pellets are formed into a bundle to the ends of which flow nozzles are attached. A brazing fixture for this purpose is described. Short tubular ferrules are placed between the rods for spacing and rigidity. Tubes are provided in some of the spaces for control rod movement. The structure offers mechanical integrity, corrosion resistance, adequate coolant flow, and satisfactory nuclear properties at an economy. (T.R.H.)

4917

FUEL ELEMENT FOR NUCLEAR REACTORS. (to Deutsche Gold- und Silber-Scheideanstalt vormals Roessler). British Patent 824,034. Nov. 25, 1959.

A fuel element is described in which a Zn layer is formed between the U and the can. This layer can be deposited either by electrolysis or vaporization. It prevents diffusion of other metals into the U to form lower-melting alloys. The Zn coating (7 to 8 μ) is preferably coated with 15 μ of Sn and then the whole is enclosed in an Al or Mg by shrink-fit, drawing, or other means. (T.R.H.)

4918

IMPROVEMENTS IN CONTROL SYSTEM. (to General Electric Co.). British Patent 824,145. Nov. 25, 1959.

A control system for fluid power systems is described in connection with dual-cycle boiling water reactors. Reactor reactivity is controlled by continuous and coordinated automatic adjustment of pressure and steam bubble formation during changing load conditions. A low-pressure valve responsive to load changes is coupled to regulate low-pressure steam flow to the load; a high-pressure valve responsive to high-pressure changes controls high-pressure steam flow to load. These two valves are coordinated to maintain substantially constant pressure and steam-void formation. (T.R.H.)

4919

IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR ARRANGEMENTS. Hugh Wilson Davidson and James Forbes Strachan (to General Electric Co., Ltd.). British Patent 824,377. Nov. 25, 1959.

It is proposed to suspend 0.5 vol. % graphite particles of 10 to 50 μ in the coolant gas of power reactors to increase cooling efficiency. A circulation system is shown. (T.R.H.)

4920

NUCLEAR REACTORS. (to Sulzer Freres, Societe Anonyme). British Patent 824,829. Dec. 2, 1959.

A pressurized-water cooled fuel element is described. Coolant tubes are imbedded in the fissile material of the fuel elements thus avoiding an extensive pressure vessel. Several fuel element-coolant tube configurations are offered. (T.R.H.)

4921

IMPROVEMENTS IN OR RELATING TO THERMAL POWER PLANTS. (to Escher Wyss Aktiengesellschaft). British Patent 824,895. Dec. 9, 1959.

A nuclear power plant with a gaseous working medium in a single cycle is described. A heat exchanger surrounds the reactor core and is enclosed in the pressure-tight core housing. This heat exchanger absorbs heat and radiation from the core and heats gas which is then compressed by a compressor. The hot compressed gas drives a turbine whose shaft operates the compressor as well as an electric generator. Thus a thermal advantage and lower shielding requirements are obtained. (T.R.H.)

4922

IMPROVEMENTS IN AND RELATING TO NUCLEAR REACTORS. Alan Robert Kirkpatrick (to C. A. Parsons & Co., Ltd.). British Patent 825,078. Dec. 9, 1959.

A reactor control rod and fuel charging system is described. Holes are provided in the outer reactor shell, each hole being placed so as to give access to one particular group of control rods and fuel channels. Thus, a device can be placed over the hole to manipulate all control rods and fuel elements for its associated group. (T.R.H.)

Research Reactors

4923 GEAP-3100

General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.

SAFEGUARD REPORT FOR OPEN POOL REACTOR FOR STATE COLLEGE OF WASHINGTON. E. G. Holzmann, Feb. 16, 1959. 70p. (R-58-APE-19). OTS.

Includes supplemental report by Harold W. Dodgen, dated Mar. 1959.

A description and safeguard evaluation are presented for open pool research and test reactor being supplied to the State College of Washington by the General Electric Company. The reactor is a 100 kw swimming pool with provisions for converting to 1 Mw operation. Experimental facilities include one graphite thermal column, six beam ports, two through tubes, and one pneumatic tube. The initial core loading is to be 3.1 kg of U^{235} to produce an average thermal flux of 0.58×10^{12} nv in the core. (W.D.M.)

4924 JAERI-1007

Japan. Atomic Energy Research Inst., Tokyo.

EXPERIMENTAL STUDIES OF THE TEST MOCK-UP FOR JRR-3. Shu Hasegawa, Susumu Harasawa, Takehiko Kinoshita, Konomo Sanokawa, Hiroshi Mitani, Tsuyoshi Tezuka, Hideo Koshii, and Mitsuo Ouchi. July 1959. 41p.

Mock-up flow tests were run on the 10 Mw(th) natural uranium heavy water JRR-3 reactor. Equipment consisted of a mock-up core tank, circulating pump, flow control system, and water level regulating system. Tests were run on the flow resistance and vibration of the model fuel element, leakage around the fuel element seat, flow distribution from lower plenum, core tank water level, fuel element flow, effect of flow control mechanism on the flow characteristics of the total system, and errors of flow measurement with orifice. (W.D.M.)

4925 NP-8130

Stanford Univ., Calif. Nuclear Technology Lab. DESCRIPTION AND SAFEGUARD EVALUATION OF STANFORD POOL REACTOR. Technical Report No. 4. Wayne S. Brown and E. G. Holzmann. June 1959. 79p. OTS.

The installation and operation of a 10 kw pool-type reactor on the Stanford University campus are discussed. Experimental facilities include a 40×40 -inch graphite thermal column and two 6-inch beam ports. Descriptions are given of the site, the building in which the reactor will be constructed, the reactor and its operating characteristics, and the operational procedures which will be employed to insure safe and effective utilization of the new facility. (W.D.M.)

4926 NP-8149

Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw.

MEASUREMENT OF THE SLOW NEUTRON SPECTRUM OF A NEUTRON BEAM FROM THE WWRs REACTOR BY MEANS OF A CRYSTAL NEUTRON SPECTROMETER. Report No. 98/I-B. D. A. O'Connor and J. Sosnowski. Aug. 1959. 18p.

The efficiency of a crystal neutron spectrometer has been determined experimentally using a two-crystal arrangement. The spectrum of a neutron beam coming from the edge of the core of the WWR-S reactor has been measured using the spectrometer in the range of neutron wavelengths 0.5 to 2.5 Å. The crystal reflection efficiency is compared with the theoretical efficiency for an ideal mosaic crystal. (auth)

4927 NP-8150

Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw.

MEASUREMENT OF SLOW NEUTRON SPECTRA IN BEAMS FROM THE EWA REACTOR. Report No. 99/I-B. E. Maliszewski. Aug. 1959. 7p.

The slow neutron spectrum of neutron beams from the EWA reactor has been studied using a simple chopper. A beam from the edge of the reactor core was found to contain a smaller proportion of long wavelength neutrons than that expected for a Maxwell spectrum. The beam from the graphite thermal column has a spectrum which is a good fit to a Maxwell spectrum. (auth)

4928

"TRITON" POOL REACTOR. A.T.E.N. Bull., No. 18, 4-6(1959) July-Aug. (In French)

The French swimming-pool reactor, Triton, and its experimental facilities and uses are described. (T.R.H.)

4929

TRANSIENT BEHAVIOR OF TRIGA, A ZIRCONIUM-HYDRIDE, WATER-MODERATED REACTOR. Richard S. Stone, H. P. Sleeper, Jr., Ralph H. Stahl, and Gordon West (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Nuclear Sci. and Eng. 6, 255-9(1959) Oct.

The transient behavior of TRIGA, a light-water-cooled reactor using fuel-moderator elements composed of uranium and zirconium hydride is described. The large, prompt negative temperature coefficient limits reactor power transients primarily by means of fuel-element temperature rise rather than by void formation in the core. Step reactivity insertions of up to 1.6% resulted in peak powers of 250 Mw with no detectable boiling of the core water or expulsion of water from the core. (auth)

4930

KINETICS OF A REACTOR COMPOSED OF TWO LOOSELY COUPLED CORES. G. C. Baldwin (Argonne National Lab., Lemont, Ill.). Nuclear Sci. and Eng. 6, 320-7(1959) Oct.

The kinetics of the two-core configuration of the Argonaut reactor is examined. In this reactor two slightly subcritical slabs two feet apart are immersed in a large graphite reflector. The system achieves criticality by the small interaction due to exchange of thermal neutrons between the cores. The kinetic equations are derived by including an interaction term with the source terms of the thermal neutron diffusion equation, and writing a separate diffusion equation for each slab. The analysis accounts for observations that the ratio of flux levels in the two cores may depart considerably from unity although the reactor shows a single stable period. It is shown that the reactivity change which a rod in one core must introduce to restore criticality after a change is made in the other core is generally not equal in magnitude to that of the change which it compensates. Flux ratio as well as period must be known to determine the excess reactivities; conventional rod calibration data must be corrected for a progressive shift in flux ratio as reactivity is traded between rods. The rod drop method is discussed with two examples; a single relation does not suffice to describe the rod drop procedure. The single transfer function of a simple reactor system is replaced by a set of six transfer functions for the two-core system, two of which are derived for illustration. Even though an oscillator may be located midway between them, the amplitudes and phases of flux in the two cores will not agree except in the special situation of identical cores and equal flux levels. (auth)

4931

DER FORSCHUNGS-REAKTOR MUNCHEN. (The Munich Research Reactor). H. Maier-Leibnitz, ed. Munich, Karl Thieme KG., 1958. 46p. (In German)

A detailed description is given of the Munich Research Reactor. It is a swimming pool reactor with 20% enriched uranium. The construction and operating data and operating conditions are tabulated. Safety factors are discussed. The reasons for the selection of the reactor type and its applications in the study of solid state physics are considered. (J.S.R.)

Power Reactors

4932 AECU-4511

Duquesne Light Co., Shippingport, Penna. REACTIVITY LIFETIME. SECTION I. THIRD PERFORMANCE, 2797-3797 EFPH. CORE I, SEED I. Test Results DL-S-225 (T-612118-B). First issue, Nov. 23, 1959. 42p. OTS.

Studies were made to determine the performance characteristics, reliability, stability, and lifetime variation of the PWR plant and core during rated power operation for an extended period of time. The PWR plant was operated at ~60 Mw net electrical output for a total of 1000 EFPH from February 3, 1959, to March 28, 1959. During this period, while performing DL-S-225, there were two planned shutdowns, no safety shutdowns or safety insertions, and only one flux tilt. The performance of the plant was satisfactory during the period of the test. (W.L.H.)

4933 AECU-4512

Duquesne Light Co., Shippingport, Penna. PERIODIC RADIATION SURVEY. SECTION I. EFPH-4182. FIRST PERFORMANCE. CORE I, SEED I. Test Results DL-S-231 (T-612394). First issue, Nov. 3, 1959. 7p. OTS.

Investigations were made to determine the radiation levels in the 1D Boiler Chamber during plant operation. The radiation level in the 1D Boiler Compartment with the 1A, 1B, and 1C main coolant loop in service at ~100% power ranged from 0.03 to 6.0 mr/hr. (W.L.H.)

4934 AECU-4513

Duquesne Light Co., Shippingport, Penna. PERIODIC RADIATION SURVEY. SECTION II. 4182 EFPH. SECOND PERFORMANCE. CORE I, SEED I. Test Results DL-S-231 (T-612394). First issue, Nov. 10, 1959. 14p. OTS.

Investigations were made to determine the radiation level in the Turbine Generator Service Building, around the Fuel Handling Canal, in the limited access areas of the reactor plant containers, and on the boiler container roofs during operation. This test was performed with the plant at ~100% power with three loops (1A, 1B, and 1C) in service. The radiation levels of the areas surveyed with a few exceptions were essentially background (0.03 mr/hr). These exceptions were the auxiliary chamber and the limited access areas between the containers. The highest radiation level obtained in the survey was 2500 mr/hr at the reactor chamber walkway. (W.L.H.)

4935 AECU-4515

Duquesne Light Co., Shippingport, Penna. PERIODIC INTERCALIBRATION OF TEMPERATURE SENSING ELEMENTS. SECTION I. SECOND PERFORMANCE. Test Results DL-S-243 (T-641303). First issue, Nov. 9, 1959. 28p. OTS.

Studies were made to determine the direction and magni-

tude of any drift in the temperature sensing elements and the receiver-indicating units for the primary loop and pressurizer resistance thermometers. Studies were also made to obtain intercalibration data for various temperature sensing elements in the primary coolant system. Of the 62 core thermocouples observed 19 were either reading less than 400°F or were reading in excess of 20°F from the calibrating thermometer temperatures. In each case the thermocouple was considered defective. The remainder were reading within 2% of the calibrating thermometers. The primary loop resistance thermometers all read within 2% of the calibrating thermometers. No conclusions could be made for the pressurizer temperature instruments or the boiler T_b resistance thermometers, except that the 1A boiler temperature varied 10 to 20°F from the 1B and 1C boiler temperatures. The data obtained from the source range nuclear instrumentation were too erratic to form any conclusion. (W.L.H.)

4936 AECU-4516

Duquesne Light Co., Shippingport, Penna. DYNAMIC RESPONSE OF REACTOR PLANT TO LOAD CHANGES. SECTION I. FIRST PERFORMANCE. CORE 1, SEED 1. Test Results DL-S-250 (T-612390). First issue, Nov. 6, 1959. 27p. OTS.

Studies were made to determine the responses of the plant when subjected to load transients exceeding the design magnitudes, and to determine the maximum load changes, positive or negative, that the plant can sustain. The reactor plant responded satisfactorily to all load changes. The only limits exceeded were the pressurizer high and low level alarm points. The magnitude of the transients and the time required for the plant to return to equilibrium was dependent upon the size of the load change. The pressurizer spray was effective in reducing reactor coolant pressure positive surges; however, this resulted in larger negative surges than when the spray valve was closed. (W.L.H.)

4937 AECU-4517

Duquesne Light Co., Shippingport, Penna. LOSS OF LEVEL IN D/P CELL REFERENCE CHAMBERS. SECTION I. FIRST PERFORMANCE. CORE 1, SEED 1. Test Results DL-S-279 (RNI-23). First issue, Oct. 30, 1959. 8p. OTS.

Investigations were made to determine the reason for the decrease in the liquid levels of the reference chambers serving the reactor plant remote liquid level indicators. The remote gages and the local liquid level gages agreed closely for the Reactor Plant Component Cooling Water Expansion Tank and the Coolant Discharge and Vent System flash tank and blow-off tank. There appeared to be no loss of water from the D/P cell reference chambers for these two systems over the period of the test. There was no definite indication of leakage from the Valve Operating System reference chamber, however, the differences between remote indicator readings and the sight glass readings are attributed to sticking of the ball check valve on the upper sight glass, inaccuracy of the readings, and instrument error. (W.L.H.)

4938 AECU-4520

Duquesne Light Co., Shippingport, Penna. MEASUREMENTS OF COEFFICIENTS OF REACTIVITY. SECTION I. SEVENTH PERFORMANCE, 5032 EFPH. CORE 1, SEED 1. Test Results DL-S-151 (T-550132). First issue, Nov. 18, 1959. 20p. OTS.

Studies were made to determine the temperature and pressure coefficients of reactivity at zero power. Data were obtained during this test which indicate a new tem-

perature coefficient of $(-1.28 \times 10^{-4})\Delta\rho/\Delta T$ and a pressure coefficient of $(1.29 \times 10^{-6})\Delta\rho/\Delta P$ corrected to station operating conditions of 500°F and 1785 psig. (W.L.H.)

4939 AECU-4521

Duquesne Light Co., Shippingport, Penna.
STATION RADIATION LEVEL SURVEY. SECTION II.
FIFTH PERFORMANCE. CORE 1, SEED 1. Test Results
DL-S-157. First issue, Nov. 18, 1959. 9p. OTS.

Studies were made to determine the level of the radiation field in the Turbine Plant during a significant power run. The initial power level survey had an average radiation level of 0.03, which was considered background level. The radiation level was far below the maximum allowable level of 2mr/hr. No neutrons were detected. (W.L.H.)

4940 AECU-4522

Duquesne Light Co., Shippingport, Penna.
CONTROL AIR CONDITIONS AT THE REACTOR CHAMBER. SECTION I. Test Results DL-S-269. First issue, Nov. 18, 1959. 6p. OTS.

Studies were made to determine the ability of the Control Air System to provide the necessary quantity and quality of clean, dry air to keep the rod drive mechanism stator and position indicator housings pressurized at about 3 psig in order to avoid low stator resistances resulting from condensation during plant cool down. The Control Air System is capable of providing the quality of air specified, of less than 44 grains of moisture per lb of air in the control air line nearest the reactor chamber. (W.L.H.)

4941 CVNA-36

Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.

RESEARCH AND DEVELOPMENT PROGRAM QUARTERLY PROGRESS REPORT FOR THE PERIOD JULY 1, 1959 TO SEPTEMBER 30, 1959. Nov. 20, 1959. 126p. For Carolinas Virginia Nuclear Power Associates, Inc. Contract AT(30-1)-2289, [Subcontract No. 1]. OTS.

Improvements were made to the methods used to calculate the resonance escape probability in heavy water moderated, clustered rod, UO_2 fueled reactors. A preliminary analog computer investigation of the externally controlled CVTR system was completed. The sensitivity of the controllers to variations in reactivity coefficients and the size of the pressurizer were determined. Proposals for prototype seal welding and cutting equipment were received from several companies. On the basis of these proposals, the vendor has been selected. The designs of several of the pressure tube components, including the seal weld lips, the connector body, and the neutron streaming plug, were modified. A Plexiglas model of the connector body and an aluminum streaming plug for use in hydraulic tests are being fabricated. The expensive circumferential corrugations in the thermal baffles were found to be unnecessary since stresses due to differential thermal expansion are low. Dimples on the baffles will be used to provide spacing between baffles. Alternative orifice designs were studied. These include single plate, multiple plate, and stacked rotating plate designs. The pressure drop tests using full-scale models of the fuel assemblies were initiated in Loop E. A study was undertaken to determine the advantages to be gained by using river water, directly, as cooling water rather than an intermediate cooling system. There are possible savings in heavy water inventory and equipment but these must be reviewed considering safety and reliability aspects. Effort was devoted toward revising the auxiliary system designs prepared for Reference Design II. Alternative designs were investigated in an effort to improve system operation or to affect cost savings. The

gamma activity contributed to the primary system by a failed fuel element and the background activity in the primary system were estimated. These data will be applied to the study of the sensitivity of the failed fuel element detection system. Information was developed for the Preliminary Hazards Summary Report which was published by CVNPA and submitted to the AEC. As a result of re-evaluation of the steam generator design in which a change in the average wall thickness of the Inconel tubing was made (from 18 BWG-0.049 in. to 19 BWG-0.042 in.), a reduction of 14% in the holdup volume was achieved. An analysis of primary coolant pressure distribution was performed which established the reactor core pressure drop as 111.3 psi. Preparation of a preliminary Equipment Specification for the design, fabrication and test of a bottom-mounted, upward-scam control rod drive mechanism was initiated. Preliminary calculations for sizing the pressurizer were completed which established the total liquid-vapor volume to be 90 cubic feet (50 cubic feet-vapor; 40 cubic feet-liquid). A study was initiated of an alternate loop neutron shield design of heavy water and stainless steel. The design would use an elevated moderator level in combination with parallel, separated steel plates to form the shield. It would avoid the difficulty of sealing a light water shield so as to avoid degradation of heavy water. A prototype of a Zircaloy-2 fuel tube support grid was successfully brazed using a Zr-5Be-15Cu brazing alloy, 1000°C temperature for one hour in a vacuum of 0.05 microns. Results of preliminary studies and consultation with vendors indicate that it will probably be necessary to machine the U-bend sections of the pressure tubes from a solid U-bend shape. (auth)

4942 DP-425

Du Pont de Nemours (E. I.) & Co., Wilmington, Del.
HEAVY WATER MODERATED POWER REACTORS.
Progress Report [for] September 1959. R. R. Hood and L. Isakoff, comps. Nov. 1959. 34p. Contract AT(07-2)-1. OTS.

The results to date of the du Pont study of natural-uranium-fueled, heavy-water-moderated power reactors are reviewed. The scope of the program and its current goals are presented. Continued progress is reported on the design and construction of the Heavy Water Components Test Reactor. The results of additional fabrication tests on prototype fuel elements of natural uranium metal and of natural uranium oxide are recorded. (For preceding period see DP-415.) (auth)

4943 HPR-1

Norway. Institutt for Atomenergi, Halden.
SAFEGUARD EVALUATION OF THE HALDEN BOILING WATER REACTOR. H. D. Brown, V. O. Eriksen, G. Jenssen, K. P. Lien, L. H. Prytz, and R. Strand. Dec. 19, 1958. 132p.

The Halden Boiling Water Reactor is situated within a rock hillside in the town of Halden, Norway. The reactor is designed to produce steam by boiling D_2O in a natural uranium metal core. General classes of accidents were studied and an effort was made to perform a quantitative evaluation of the worst accident within each category. The hazards analysis shows that the plant possesses a high degree of inherent safety. It appears that the pressure system will withstand all accidents except the mechanical failure of the system itself. (W.D.M.)

4944 JAERI-1006-A

Japan. Atomic Energy Research Inst., Tokyo.
TEMPERATURE COEFFICIENT OF REACTIVITY OF CALDER HALL TYPE REACTOR. Kazuhiro Inoue, Masasi Iizumi, and Kazuo Nishimura. June 1959. 20p.

As the conversion ratio of the fuel is comparatively high for the Calder Hall type reactor, about 0.8, considerable amounts of Pu^{239} are built up in a relatively short irradiation time. As Pu^{239} has a large resonance absorption for the neutron energy of about 0.3 eV, the reaction rate of Pu^{239} increases as the temperature increases, in contrast with the reaction rates of U^{235} and U^{238} which show the opposite tendency. Though the temperature coefficient of reactivity is negative for fresh fuel, it changes to positive as the exposure proceeds and Pu^{239} is accumulated. The moderator temperature coefficient becomes zero at an irradiation of about 150 Mwd/ton, and exceeds $+10^{-4}/^{\circ}\text{C}$ at about 2,000 Mwd/ton. The fuel temperature coefficient is almost constant, about $-1.7 \times 10^{-6}/^{\circ}\text{C}$, throughout the exposure. The fuel temperature coefficient is a prompt one, and the moderator temperature coefficient shows the delayed property owing to the large heat capacity of the graphite. Consequently, the negative fuel temperature coefficient is effective at first, although the over-all temperature coefficient is positive at high exposure, and the operation of the reactor is not so difficult essentially. A calculation of these changes of the temperature coefficient of reactivity is presented and an investigation on the effect of the increases of enrichment of U^{235} on the temperature coefficient is presented. (auth)

4945 JAERI-1006-B

Japan. Atomic Energy Research Inst., Tokyo.
ANALYSIS OF DYNAMIC CHARACTERISTICS OF BRITISH TYPE GAS COOLED REACTORS. Junichi Miida, Masao Hara, Nobuhide Suda, Yasumasa Togo, and Keiichi Mochizuki. June 1959. 59p.

The positive temperature coefficient of reactivity which a British type reactor obtains over a certain irradiation level of its natural uranium fuel, has presented a new problem to the inherent safety of this type of reactors. An analysis is described of the dynamic characteristics of three British type reactors with positive temperature coefficient of reactivity, using an analog computer. The three reactors considered are Calder Hall Reactor, the power reactor proposed to the Japan Atomic Power Company by G.E.C. of Britain, and Hunterstone Power Reactor. Here, they are referred to as R-I, R-II, and R-III, respectively. Setting up a rather simplified model, transient characteristics of R-I were studied at first, applying several disturbances to the reactor such as change in reactivity, coolant inlet temperature, and coolant flow. Secondly, composing more complex equations of a thermal system on R-II, the same study was made. In this case the effect of the sleeve and radiative heat transfers between the clad and sleeve, and the sleeve and moderator were taken into consideration. Thirdly, more detailed and comprehensive study was pursued on R-III, although the same equations as those of R-II were applied to the thermal system of this reactor. Results obtained on R-I, R-II, and R-III were compared and analyzed. Virtual time constant of the thermal system and critical value of the positive temperature coefficient of moderators for these reactors were investigated. (auth)

4946 JAERI-1006-C

Japan. Atomic Energy Research Inst., Tokyo.
AN ANALYSIS OF NEUTRON FLUX SPATIAL OSCILLATION DUE TO XENON BUILD-UP IN THE BRITISH LARGE POWER REACTOR CORE. Keiichi Mochizuki. June 1959. 32p.

Neutron flux spatial oscillation due to xenon build up in the reactor core is a well-known characteristic in the large power reactor. Especially the reactor with a positive

temperature coefficient of reactivity tends to have such a characteristic. An analysis was pursued on a British Power Reactor. Specific features taken into consideration were a large neutron flux flattened zone in the core and a graphite sleeve in each coolant channel. First, the threshold values of the temperature coefficient to initiate oscillation of successive order of modes in radial and azimuthal directions as well as oscillation periods were calculated. Secondly, the effect of sleeve on threshold value and oscillation period was investigated. Thirdly, in order to clarify this phenomenon, a vector analysis was made which helps to understand the critical condition to initiate the oscillation as well as the relation between effects of neutron leakage, temperature coefficients of fuel and moderator, and xenon poisoning. (auth)

4947 KAPL-ADM-1408

Knolls Atomic Power Lab., Schenectady, N. Y.
SAFEGUARDS ANALYSIS OF THE FLEXIBLE PLASTIC REACTOR. S. W. Kitchen, J. S. King, and J. J. Fitzgerald. Sept. 20, 1955. Decl. Nov. 9, 1959. 43p. Contract W-31-109-Eng-52. OTS.

A description is given of the Flexible Plastic Reactor. A procedure for safe operation is given including operational sequence of the automatic scram system and enumeration of the various shutdown mechanisms. The potential biological effects associated with a maximum incident are discussed. (C.J.G.)

4948 MND-MPR-1581

Martin Co. Nuclear Div., Baltimore.
MARTIN DESIGN REPORT—ICE CAP NUCLEAR POWER PLANT. Robert J. Akin. Jan. 1959. 381p. Contract DA-44-009-ENG-3635.

Analytical data on the nuclear, shielding, and component aspects of the plant are presented. The equipment and design and the installation and testing of the plant at both the contractor facility and the customer site are described. The maintenance and refueling program for the plant are discussed. Cost estimates, a master schedule, and an account of the design engineering performed to adapt the basic system to the required load are given. (W.D.M.)

4949 NAA-SR-1132

North American Aviation, Inc., Downey, Calif.
THE PLUTONIUM FEEDBACK APPROACH TO NUCLEAR POWER. Charles Roderick. Apr. 15, 1955. Decl. Oct. 7, 1959. 89p. Contract AT(04-3)-49. OTS.

Nuclear parameter variations are presented for sodium graphite reactors using Pu-spiked natural U as fuel. The fuel feed is assumed to be natural U, and the important variables are the initial amount of excess reactivity, lattice spacing, and α , the ratio of Pu^{239} to U^{235} in the feed material. The system is called "steady state" in that the ratios, $N_{40}/N_{49} = \sigma_{c(49)}/\sigma_{a(40)}$ and $N_{41}/N_{49} = \sigma_{c(49)}/\sigma_{a(41)}$, obtained from setting the build-up equations to zero are assumed for the feed concentrations, and the feed material to the reactor is always the same. During irradiation, the U^{235} and U^{238} concentrations steadily decline while the Pu isotope concentrations initially increase, then decline. To ensure sufficient plutonium for feed material, it is necessary to remove the fuel from the reactor before the Pu content drops below its initial value. Although the reactivity variations presented were calculated specifically for sodium graphite reactors, they may be applied to any thermal reactor using Pu-spiked natural U as fuel. The reactivity changes are determined primarily by the fuel characteristics and are only slightly dependent on the other material in the reactor core. An analysis which estimates the effect of Pu feedback operation fuel costs is given. (auth)

4950 NAA-SR-1990

Atomics International Div., North American Aviation, Inc.,
Canoga Park, Calif.

ANALYSIS OF CYLINDRICAL STAINLESS STEEL CANNED MODERATOR ELEMENTS FOR A SODIUM GRAPHITE REACTOR. W. P. Corcoran, R. C. Gerber, J. E. Mahlmeister, and R. F. Wilson. Dec. 15, 1957. Decl. Nov. 9, 1959. 110p. Contract AT-11-1-GEN-8. OTS.

A method of analysis is presented for reactor core designs including the nuclear, heat transfer, fluid flow, and fuel cost parameters. The method interrelates the above parameters such that the over-all affect on power costs, by changing certain design parameters, can be evaluated. To illustrate this method of analysis a design concept was chosen and evaluated. This design concept was a Na graphite reactor with cylindrical stainless-steel clad moderator elements and 13-rod U metal fuel elements located in the interstices between the moderator cans. In the economic analysis the fuel costs and the variations in power costs of a 250 Mw(t) reactor are determined for core sizes ranging from 50 to 90 inches. The results of the economic evaluation indicate that power costs continuously decline for an increasing core radius if the Pu value is between 12 and 30 dollars per gram. An increase in core radius beyond a 74-inch reference design results in negligible savings. (auth)

4951 NAA-SR-3912

Atomics International Div., North American Aviation, Inc.,
Canoga Park, Calif.

SELF-SUSTAINING PLUTONIUM RECYCLE IN SODIUM GRAPHITE REACTORS. T. J. Connolly. Sept. 1, 1959. 45p. Contract AT-11-1-GEN-8. OTS.

A study was undertaken to determine whether a sodium graphite reactor (SGR) could be designed to achieve self-sustaining plutonium recycle. The current design makes use of stainless steel for fuel and moderator cladding. It requires a fuel enrichment of about 3% uranium-235. The reactivity requirements of such a reactor are too high for self-sustaining plutonium recycle to be achieved, because eta for the equilibrium plutonium is less than is required for the fuel. However, certain design modifications and the development of cladding materials of lower neutron absorption offer good promise of reducing SGR fuel reactivity requirements. The purpose of the present study was to determine whether, in the light of these probable advances, self-sustaining plutonium recycle could be achieved in a SGR. This effort was limited in scope to the technical feasibility, although certain economic factors such as fuel burnup are also considered. It appears technically feasible to design a SGR to operate on self-sustaining plutonium recycle. Such a reactor, however, would of necessity have a large core and low (for an SGR) volumetric power density, and would require exclusive use of a low cross-section material such as zirconium alloy for cladding and core structure. The fuel specific energy yield and uranium-235 burnup attainable is uncertain, but appears to be on the low side, perhaps 3000 to 5000 Mwd/t, and 25 to 40% uranium-235 burnup. Such a system would almost certainly compare unfavorably with a slightly enriched SGR if the fuel inventory annual rate and the unit costs for uranium-235 enrichment and for fuel fabrication and reprocessing, currently prevailing in the United States are applied. Expressed in a different way, it appears that an optimized plutonium recycle case will require some enrichment of the uranium feed. These conclusions in large measure reflect the low reactivity of plutonium as a reactor fuel and, therefore, they apply in general to other thermal reactor systems. (J.R.D.)

4952 NAA-SR-3969

Atomics International Div., North American Aviation, Inc.,
Canoga Park, Calif.

PRELIMINARY TEST OF NATURAL-CIRCULATION DOUBLE-TUBE STEAM GENERATOR. R. D. Welsh. Dec. 1, 1959. 35p. Contract AT-11-1-GEN-8. OTS.

Testing of the Natural Circulation Steam Generator was conducted with the Sodium Reactor Experiment. A necessary modification of the original feedwater control system was utilized. Transient and steady-state tests were run at power levels up to 19.5 Mwt. All tests indicate that the steam generator responds well and is stable. Over-all heat transfer coefficients for the boilers and superheater are, respectively, 507 and 180 Btu/hr-°F-ft². These values are within 11.5% of the theoretical values, 449 and 169 Btu/hr-°F-ft². Reverse sodium flow occurred in the lower tubes of the boilers, as predicted, when the temperature gradient across the boilers was 94°F and the total sodium flow for the two boilers was 35 gpm. Recommendations are given for further steam generator tests and improvements. (auth)

4953 NAA-SR-4065

Atomics International Div., North American Aviation, Inc.,
Canoga Park, Calif.

HAZARDS ANALYSIS OF THE ORGANIC MODERATED REACTOR EXPERIMENT. R. O. Williams, Jr., ed. Dec. 15, 1959. 259p. Contract AT-11-1-GEN-8. OTS.

An attempt is made to determine the behavior of the OMRE under extremely unlikely sets of conditions and to provide additional design information in the areas of reactivity coefficients, burnout heat flux, and reactor control. In establishing an upper boundary on the severity of an accident in the OMRE, three extreme cases were considered: (1) a loss of flow resulting from the simultaneous seizure of both coolant pumps; (2) a system rupture of varying proportions; and (3) an insertion of reactivity of varying amounts. The OMRE control philosophy is discussed, and a résumé of the stability analyses performed on the OMRE is given. (W.D.M.)

4954 NAA-SR-4180

Atomics International Div., North American Aviation, Inc.,
Canoga Park, Calif.

POWER FLATTENING IN SODIUM GRAPHITE REACTORS BY SPATIAL VARIATION OF MODERATOR PROPERTIES. T. J. Connolly. Dec. 15, 1959. 27p. Contract AT-11-1-GEN-8. OTS.

A preliminary evaluation of the effectiveness of two power flattening expedients, which have particular advantages in the case of solid-moderator, fixed-fuel power reactors, was made. These expedients are the variation of moderator composition with position in the core and variation of moderator density with position in the core. Among the advantages peculiar to these techniques are: (1) no parasitic material is introduced, (2) no variation in the enrichment is required, and (3) the method is applicable in the axial as well as radial direction. In the present study, the variation of moderator composition was postulated to be effected by the inclusion of varying amounts of beryllium oxide in the graphite of an SGR. One-dimensional, two-group diffusion theory calculations were performed for multiregion SGR lattice models in which moderator composition or density was varied from region to region. Increases in average-to-peak power generation as high as 40% were calculated. The interrelation between degree of power flattening, beryllium oxide quantity, and effective multiplication is shown. The shortcomings of the calculation techniques and possible incentives for power flattening

in terms of nuclear power cost reduction are discussed. (auth)

4955 NAA-SR-4510

Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.

CORE PARAMETER SURVEY REPORT FOR ORGANIC COOLED REACTORS. R. W. Hardy and B. L. Hoffman. Dec. 15, 1959. 51p. Contract AT-11-1-GEN-8. OTS.

The study was undertaken to provide data concerning the effect on total power generation costs of perturbations of some major nuclear core parameters. The reference design plant has a design capability of 1020 Mw(th) and is cooled and moderated by commercial terphenyls. The economic effects of core parameter perturbations and an evaluation of cost reductions which may be attained by improvement of the organic reactor concept through technological developments are presented. (W.D.M.)

4956 NAA-SR-Memo-902(Rev.)(Del.)

North American Aviation, Inc., [Downey, Calif.].

PRELIMINARY SAFETY EVALUATION OF THE SODIUM REACTOR EXPERIMENT. W. E. Abott, ed. Feb. 19, 1954. Decl. Nov. 9, 1959. 29p. OTS.

A description is given of the Sodium Reactor Experiment (SRE) facilities and program of objectives. The hazards associated with equipment failures and malfunctions, personnel errors, natural causes, and operation are evaluated. (C.J.G.)

4957 ORO-196 and Suppl.

Kaiser Engineers Div., Henry J. Kaiser Co., Oakland, Calif. and Allis-Chalmers Mfg. Co. Atomic Energy Div., Washington, D. C.

EXPERIMENTAL GAS-COOLED REACTOR; PRELIMINARY HAZARDS SUMMARY REPORT. May 1959. 268p. Contract AT(10-1)-925. OTS.

The EGCR is a combined experimental and power demonstration reactor which is to be constructed at Oak Ridge. It is fueled with enriched UO_2 , clad in stainless steel, moderated with graphite, and cooled with He. The plant is designed to produce 85 Mw(th) and 25 Mw(e) at a gas outlet temperature of 1050°F. The core and vessel of the EGCR can accommodate eight tubes through the core, into which experimental loops will eventually be installed. Accidents analyzed include both reactivity accidents and component failures and malfunctions. The maximum allowable once-in-a-lifetime dose of 25r is not exceeded within 8 hr at the nearest uncontrolled land. (W.D.M.)

4958

BBC HIGH-TEMPERATURE REACTOR. R. Schulten (BBC-Krupp, Mannheim, Ger.). Atom u. Strom 10, 79-82 (1958). Oct. (In German)

High-temperature reactors in general are discussed and compared as to fuel elements, materials, temperatures, and other characteristics. The BBC-Krupp design is described. (T.R.H.)

4959

150-MW NUCLEAR POWER STATION AT TOKAI-MURA, JAPAN. G.E.C. Atomic Energy Rev., 2, 55-8(1959) Sept.

A brief description is given of the design for the 150-Mw nuclear power station to be built at Tokai-Mura, Japan. Design parameters are tabulated. The station will have one reactor, of the gas-cooled, graphite-moderated type, using natural-uranium fuel. Special precautions were built into the design to guard against the effects of earthquakes. (auth)

4960

A NUCLEAR REACTOR INSTALLATION FOR MARINE USE. M. C. Hartnell-Beavis. G.E.C. Atomic Energy Rev. 2, 60-9(1959) Sept.

A nuclear marine-propulsion installation was recently designed. The reactor is of the gas-cooled, graphite-moderated type, using slightly enriched uranium dioxide and with facilities for on-load changing of fuel. The whole reactor, steam-raising system, and radiation shielding for a 20,000-shp installation is contained in an outer steel vessel, with maximum dimensions of 44 ft long, 37 ft high, and 35 ft wide. Total weight is about 2000 tons, and initial cost just over £2 million. Reasons for the choice of system, a fairly detailed description of the design (with a table of the principal parameters), and discussion of its safety are given. Cost comparisons with conventional engines are given for installations in a large oil tanker and a large passenger liner. (auth)

4961

THE DESIGN AND CONSTRUCTION OF THE BIOLOGICAL SHIELD AT HUNTERSTON. PART I. S. Gill. G.E.C. Atomic Energy Rev. 2, 77-85(1959) Sept.

The function of biological shields for nuclear reactors is reviewed. Details and illustrations are given of the arrangement adopted for the reactors now under construction for the Hunterston nuclear generating station. A full discussion is given of the types of concrete used and the methods adopted for ensuring consistent quality. (auth)

4962

NRU REACTOR NEUTRON LEVEL CONTROL SYSTEM. C. G. Lennox and A. Pearson (Atomic Energy of Canada Ltd., Chalk River, Ont.). IRE Trans. on Nuclear Sci. NS-5, No. 2(1958) Aug.

A control system was developed for the NRU reactor which performs automatic start-up as well as steady power control. The system characteristics and the circuits which determine them during start-up and under steady power control are described. (auth)

4963

DRESDEN GOES CRITICAL. PART II. U.S.A.'S FIRST BWR STATION. Nuclear Energy Engr. 13, 583-6(1959) Dec.

Design features discussed include: basic turbine features, pumping equipment, effluent disposal equipment, and the fuel storage vault. The methods of control for start-up, normal operation, shutdown, scrambling, and increased load demand are described. (C.J.G.)

4964

THE INDUSTRIAL CHALLENGE OF NUCLEAR ENERGY. III. STRESA CONFERENCE. PART I. SURVEY OF EUROPEAN PROGRAMMES. ECONOMICS OF NUCLEAR POWER. FINANCING OF PROGRAMMES. Paris, The Organisation for European Economic Co-operation, 1959. 275p. \$3.00.

A survey of the nuclear power programs of Canada, France, Federal Republic of Germany, Italy, Netherlands, Norway, Sweden, and the United Kingdom is presented. Discussions are given on the economics and financing of the programs. Estimates of nuclear energy production in Europe for 1958 to 1965 are given. (C.J.G.)

4965

THE BBC-KRUPP HIGH-TEMPERATURE REACTOR. 8p. (In German)

The BBC-Krupp high-temperature pellet-fueled reactor and its fuel elements are described. (T.R.H.)

Production Reactors

4966 HW-42552

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

HANFORD CONTROL INSTRUMENTATION AND PROCEDURES. G. C. Fullmer. Apr. 6, 1956. Dec. 7, 1959. 13p. Contract W-31-109-Eng-52. OTS.

Technical bases, operating standards, and instrumentation systems required to achieve the goal of nuclear safety in the operation of high-level reactors are discussed. Because of the relatively long neutron lifetime in a thermal reactor and the comparatively modest time rates of reactivity change associated with fission poison and temperature effects, the rod system used for compensating reactivity transients and for maintaining flux distribution control may be operated manually. Manual operation of the reactor and the prediction of pile reactivity status during outages of course involve factors of human error, normal reaction time, and judgment. Technical considerations used in developing safety standards for reactor manual control are discussed relative to monitoring and automatic trip devices. (auth)

4967

BREEDING POTENTIAL OF THERMAL REACTORS.

J. Chernick and S. Oleksa Moore (Brookhaven National Lab., Upton, N. Y.). Nuclear Sci. and Eng. **6**, 537-44 (1959) Dec.

The breeding potential of thermal reactors is re-evaluated on the basis of present nuclear data. It is concluded that positive breeding on the U^{233} , thorium cycle is possible with a variety of moderators including heavy water, graphite, beryllium, and ordinary water. Current measurements indicate that the accepted thermal value of

$\eta_{23} = 2.28 \pm 0.02$ is somewhat conservative. Neutron spectrum considerations show that η_{23} decreases gradually with increasing resonance absorption to a minimum of 2.14 ± 0.04 . When neutron losses to the moderator are considered, maximum breeding gains of 0.26, 0.22, 0.21, and 0.19, respectively, are obtained for D_2O , graphite, Be, and H_2O moderated reactors. The breeding gain in reactors partially or completely moderated by beryllium can be considerably increased if use is made of the fast effect, presently estimated at 1.075 ± 0.02 for pure beryllium. Probable breeding gains in proposed full-scale fluid fuel breeders are estimated at 0.09 for the Aqueous Homogenous Reactor and 0.05 for the graphite moderated Liquid Metal Fuel Reactor and Molten Salt Reactor. Breeding in predominantly thermal, solid fuel reactors also appears within reach if neutron losses are minimized. The possibility of positive breeding in near thermal, plutonium fuelled reactors is unsettled although this goal can be approached by maximum use of the fast effect in U^{238} . Estimates of breeding ratios in plutonium fuelled reactors depends on the variation of η_{49} with neutron temperature which is still inadequately known. (auth)

WASTE DISPOSAL AND PROCESSING

4968

TREATING AND DISPOSING OF RADIOACTIVE WASTES.

W. J. George (Wyandotte Chemicals Corp., Wyandotte, Mich.). Chem. Eng. **66**, No. 25, 151-5 (1959) Dec. 14.

The problem of handling and storage of radioactive waste is discussed. The treatment of wastes by evaporation, fixation in solids, precipitation, ion exchange, and calcination is described. Ultimate disposal methods such as salt cavities, deep wells, and ocean burial are described. (W.L.H.)

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Vienna, International Atomic Energy Agency

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